

**MARINE RECREATIONAL FISHING IN  
THE MIDDLE AND SOUTH ATLANTIC:  
A DESCRIPTIVE STUDY**

Report on Cooperative Agreement #CR-811043-01-0 between the University of Maryland and the Environmental Protection Agency, National Marine Fisheries Service, and National Oceanic and Atmospheric Administration.

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## **DISCLAIMER**

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# Chapter 1

## THE PURPOSE OF THE RESEARCH

This report is the descriptive phase of a research project on the economics of marine recreational fishing along the Middle and South Atlantic coast of the U.S. It describes the data from three large surveys on sportfishing, surveys that will form the basis of a subsequent phase of the research project. This first phase provides a broad-brushed picture of saltwater fishing during the 1980's and serves as a foundation for a more comprehensive economic study yet to come.

Analysis of the data from the three surveys requires an appreciation for the ultimate use the data will serve. The next phase of the research involves a comprehensive economic study with two goals: to estimate the economic value of access to marine recreational fishing and to estimate some of the economic damages to marine recreational fishing from pollution of marine waters. In concept, economic value of access is simple. Like any other activity, recreational fishing has economic value, in the sense that anglers would be willing to pay for the opportunities that they enjoy. We accept this commonly used measure as the value of access. It will vary along the coast, among seasons, and depending on the kind of fish that anglers pursue.

The second goal of the research, measuring the economic damages from pollution, is more complex. Studying the links from increased pollution of marine waters involves physical, chemical, and biological oceanography. Effluents are emitted by firms, households, and other enterprises. These effluents are borne by water and air to water bodies. There, they affect

physical and chemical water quality and plant and animal life. Human well-being depends on both the quality of the water and the abundance of species that live in the water. Human well-being suffers when water quality declines, even when the robustness of species remains unchanged, because water quality directly influences activities like swimming. Well-being also suffers when the abundance of plant and animal populations declines even though water quality remains unchanged, because activities like recreational and commercial fishing become less productive. Species of fish may be affected directly by pollutants, such as heavy metals, or they may be affected indirectly by changes in the water quality. For example, excessive nutrients may lead to lower dissolved oxygen, which in turn impacts on some fishery stocks.

We address the final link in the causal chain: the effect of changes in fish stocks on human well-being. Changes in well-being are measured by the amount of money people will accept to avoid the loss in fish stocks. And to make our work even more manageable, we deal with the impact of changes in catch rates which result from changes in the availability of fish stocks.

The research is motivated by the idea that the economic value of marine recreational fishing is an important component in many resource management decisions that the public sector makes in the marine environment. Fishery management increasingly must deal with trade-offs between recreational and commercial fishing. Estuarine development which affects marine habitat ultimately influences the economic value of recreational fishing. This value, whether explicitly considered or not, plays a role in such development. Enhancement of stocks requires a budget and usually there is an accounting for the economic value of sportsfishing, whether implicitly or explicitly. Our research is motivated by the belief that the explicit consideration

of the economic value will lead to better resource use. The ultimate goal of this research is to provide a comprehensive set of economic values for marine recreational anglers in the Middle and South Atlantic and thus provide a foundation in which future recreational policies can be evaluated.

Consequently, while the research project deals broadly with the impact of marine pollution on human well-being, we investigate only the last link in this complex process: the effect of changes in catch rates on the economic value of recreational fishing to people who do the fishing. Given the nature of the available data, we can investigate issues that arise only at the state level or perhaps at the county level within a state. Our study area is the Atlantic coast from Long Island south through Florida, excluding the Keys. We thus have considered a large domain, but a small part of the potentially large geographical range of marine pollution. However it is an area which accounts for a substantial portion of the nation's marine recreational fishing and it is part of a larger strategy to document the economic value of marine natural resources.

Methods for estimating economic value blend statistical methods and economic models with data on how people have carried out their recreational fishing activities. Information on recreational fishing is not easy to come by. Marine recreational activity is a highly diverse activity. It occurs over wide geographic areas and in many different ways. In particular, anglers seek a sportfishing experience, a good not sold in a market, but available because of the existence of a natural resource and attainable through household decisions to allocate time and money for this purpose. The absence of a market not only necessitates a study to measure the economic damages, but it also requires special surveys to gather information on the behavior of recreational anglers. There is no market operating which would provide secondary statistics for

our study. Consequently, as part of this study we have engaged directly or indirectly in preparing survey data which can be used to infer both the economic value of marine recreational fishing and how this value changes with factors which depend on the quality of marine water, such as catch rates.

The necessity of gathering data for studying the economic value of marine recreational fishing explains the role of this particular report. In a study for an area as large as New York to Florida, a great many observations on behavior are needed. We have engaged in extensive construction of data sets from surveys conducted by and for the National Marine Fisheries Service over the last ten years. In this report, we describe these data sets. It is written with the hope that others may find the data that we have used of interest. But the work that went into the report is also a step along the way to measuring the economic value of recreational fishing.

As such, a gap in the current literature about marine recreational fishing is filled. There is relatively little comprehensive information about marine sportfishing. Local and state guides are meant to attract tourists and encourage the local anglers. Aggregate data from the national surveys conducted by the Department of Interior (Fish and Wildlife Service) and the Department of Commerce (National Marine Fisheries Service) are written to provide snapshots of the level of aggregate activity on a five year or one year basis. They have not been organized to reveal how the fisheries are changing over time, nor have they been used to compare the activities in different states. In this report, we provide descriptive information on sportfishing from New York to Florida. This information is organized in terms of trends in participation and catch rates by state, as well as some current descriptive economic information. In addition to the data

description, a simple analysis of trends in participation and trips is presented. Although not rigorous in method, the results are provocative.

### **The Marine Recreational Fishing Surveys**

In this report, marine recreational fishing on the Atlantic coast is analyzed with data from three surveys. Two of the surveys are part of the Marine Recreational Finfish Statistical Survey sponsored by the National Marine Fisheries Service (NMFS). They are the Intercept Survey and the Household Telephone Survey (Phone Survey for short). The third survey was conducted as part of this project at the University of Maryland, to provide information for the economic aspects of the study (called the UMCP survey for short). The UMCP survey was designed to generate information necessary for estimating economic models, and that remains its main attraction. However, the NMFS surveys were originally designed with the task of estimating total recreational catch in mind. Some understanding of these surveys can give an appreciation of the strengths and weaknesses of our statistical descriptions as well as the role these surveys play in estimating recreational catch.

#### **The NMFS Surveys**

Knowing how NMFS uses its survey to estimate total catch is essential to understanding the surveys themselves. The goal of the surveys is to estimate total catch. In principle, the procedures are clear. An estimate of the total catch of a species by geographical area and time period (say a year) can be made from the mean of the number of fish caught per trip times the number of trips. The principal goal of the Intercept Survey is to estimate the number of fish caught per trip. The Phone Survey is used to estimate the number of fishing trips in the area of

interest. The product of the mean catch rate and the number of trips is the estimate of total catch. These surveys are carried out independently of each other, by contractors for NMFS.

### **The Phone Survey**

NMFS initiated the Phone Survey in 1979. The survey is conducted by a commercial contractor. It is a random-digit-dialing survey of households living near the coast. Households are interviewed at the end of a two-month wave and asked about their recreational fisheries activities during that previous two-month period. For most of the states in our study area, sampling is undertaken in only five two-month waves: March-April, May-June, July-August, September-October, and November-December. No surveys are conducted for the January-February wave except for Florida and Georgia. To standardize our results, this wave has been omitted from all state reports.

For the most part, calls are made only to households located in counties within 25 miles of the coast or of major bays or estuaries. The random digit dialing procedure accepts only households. The interviewer first asks whether anyone in the household has fished during the last two months. The interviewer then attempts to talk to all household members who had fished during the previous two months.

The survey includes questions about whether any member of the household fished within the last two months. Each member is asked the following questions about each trip taken within the last two months:

- from what fishing mode?
- using what gear?

- in what type of waterbody?
- how far from shore?

The questions have remained approximately the same over the life of the survey, although some revisions took place between the 1980 and 1981 survey. Starting in 1981, respondents were specifically asked for information only if they fished in-state, and since that time trip information has been coded only for in-state trips. Additionally, information has been coded since 1981 only for those households in which at least one member fished in the interview wave.

The telephone survey is critical to the entire survey scheme because it is the only instrument applied randomly to households residing in defined geographical areas. Without it, there would be no way to obtain participation rates or estimates of total numbers of sportfishing participants or trips. Since the telephone survey samples only coastal residents and includes only in-state trips, information from the field survey must be combined with the telephone survey results to extrapolate participation and trips of non-coastal and out-of-state residents.

The telephone survey is designed to elicit responses about fishing in the previous two months, because accurate recall beyond that period is considered questionable. However, the two-month wave design introduces some unusual problems for traditional economic analysis, which is typically based on yearly behavior. For example, it is not feasible to obtain good estimates of the annual participation rates by households or by individuals from the Phone Survey.

Variations in the range of households interviewed cause additional problems for the two-month participation rates. For the Mid-Atlantic region (New York, New Jersey, Delaware, Maryland and Virginia) only counties within 25 miles are called in all waves. For the South

Atlantic, excluding North Carolina (South Carolina, Georgia and Florida), households are sampled from counties within 25 miles of the coast during the March-April and November-December waves,<sup>1</sup> but from counties within 50 miles of the coast from May through October. The sampling in North Carolina was the same as the rest of the South Atlantic until 1987. Since 1987, households in North Carolina are sampled from 50 mile counties in March-April and November-December and from 100 mile counties in May through October. These complications are summarized in Table 1 below for reference. The variation in the sample frame raises difficulties in analyzing the trend in participation rates.

In the state reports that follow, the first five tables are based on the Phone Survey. These tables report on trips and participation by wave and mode at the state level. In using the Phone survey, we have modified the raw survey data to correct the original weighting scheme. In the original sample frame, the sample within a state was distributed among counties by a weight proportional to the square root of the county's population. We have reweighted so that the observations from different counties are proportional to the county's population, and not the square root of the population.

The percent of households called in which at least one individual sportfished for finfish within his state of residence during the wave is reported in the first table of each section. Only households residing in counties within 25 miles of the coast or major bays or estuaries are sampled for the mid-Atlantic states and during waves 2 and 6 for the South Atlantic states. During waves 3 through 5, counties within 50 miles of the coast or major estuaries and bays are

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<sup>1</sup>Also during the January-February wave for Georgia and Florida. However, for consistency across states we have omitted this first wave from consideration.

called for the South Atlantic states. North Carolina data since 1987 represents the only exception, covering 50 miles in waves 2 and 6 and 100 miles 3 through 5.

The second table in each section is created to analyze the trends in the participation rates for the decade 1980-89. Each state's participation rate by wave is regressed against a time trend variable and the results presented in the table. In cases where the sampling frame changed, we have used binary variables to remove the effect of the change from our analysis.

The third, fourth and fifth table of each section show information on trips per household by wave and mode. This information is taken from the individual responses to the questions about the actual trips taken during the two month period. In the cases where an individual was recorded as having fished, but did not come to the phone, we have assumed his total trips to be equal to one. This method is the most conservative that we could devise in the absence of more information about the missing angler's trips.

### **The Intercept Survey**

The Intercept Survey was also initiated in 1979. It is conducted by commercial contractors, but usually with substantial involvement from state fisheries agencies. The Intercept survey is organized along the same two month waves as the Phone survey. The Intercept survey is designed to be a random survey of fishing trips. Each state survey is sampled separately, because of the close working relationship with the state agencies. The survey is a type of cluster survey, where the basis of cluster is a site. The commercial contractor to NMFS typically keeps a list of fishing sites, the kinds of activities that occur there, the typical level of its use during different seasons, and other attributes. The sites to be sampled can then be chosen first, with a specified level of sampling effort assigned to each chosen site. The site list changes slightly over

time and keeping track of those changes is a challenge. There are over 1000 sites in our study area.

The Intercept survey protocol determines how anglers at a particular site are to be chosen. Those fishing from shore are interviewed as they are intercepted. Boat anglers are interviewed after their fishing trip (although occasionally interviewers accompany anglers on party boats and interview during the trip). The intercepts are sampled by mode. The four aggregate NMFS modes are party/charter boat fishing, private/rental boat fishing, beach/bank fishing, and fishing from artificial structures. This covers most recreational fishing, omitting only those anglers who moor their fishing boats at home or other moorings inaccessible to sampling. We have aggregated the beach/bank and artificial structures into a single mode, the shore fishing mode. The method of interview varies by mode. The aggregate sampling effort within a state varies by wave, with more effort naturally given to the waves when the angling effort is likely to be large.

The focus of the NMFS interview is on the current trip of the angler. In essence, it is a creel survey, with some additional social and economic data gathered. Each angler interviewed is asked

- place of residence
- length of trip
- target species
- number and species of fish caught.

In addition, the interviewer measures the weight and length of a sample of the fish caught by the angler. Anglers are also asked about the number of trips they have taken in the past twelve months and in the past two months.

The NMFS Intercept survey is an excellent method for gathering information about fish caught by individual anglers. The few weaknesses are inevitable and well known by the survey designers. Boat anglers pose problems, for example, because they tend to group catch together and so it is difficult to determine the fish caught by an individual angler. Fish which are caught and thrown back cannot be weighed and measured, and the species may not be known. One difficulty for the estimation of economic models from intercept data is that the random sampling of trips does not result in a random sample of individuals. This causes no damage to our descriptive report, but will require attention as we pursue our economic analysis.

The Intercept Survey is a substantial undertaking. Over the period from 1980 to 1989, over 200,000 anglers have been interviewed in the Middle and South Atlantic. Because the purpose the Intercept survey is to assess catch per trip of individual species, much effort has gone into accurately measuring the number and weight of fish caught by anglers. But this purpose is slightly different than ours, so modifications of the data have been made.

Our challenge is to utilize the data in a manner that will reflect those characteristics of a fishing trip which influence angler's behavior. The most obvious characteristic is the expectation of how many fish the angler can expect to catch on any given trip. Consequently our aggregation schemes group species in ways that reflect individuals' perceptions and targetting behavior.

In forming measures of catch rates which influence behavior, we aggregate because the site-wave-species combination provides data too sparse to allow good estimates of catch rates. There are at least 25 significant species that anglers seek in the study area. There are four modes, five waves, and ten years of sampling. Even if the distribution of fishing were uniform across the modes, waves, species, and sites, a uniformly distributed sample of 100,000 would encounter only one of every five mode-species-wave-year-site cells. Naturally the sample is not evenly distributed over sites. As a consequence of the diversity of these characteristics, we have been compelled to aggregate.

In the state sections that follow, we have aggregated in three significant ways:

1. Over modes: The two NMFS shore modes, bank/beach fishing and fishing from artificial structures, have been aggregated into one shore fishing mode.
2. Over sites: Instead of providing information by site, we have aggregated all the sites within each state to the state level. All of the catch information is provided at the state level.
3. Over species: The most important aggregation is over species. There are simply too many different species to present trends of catch rates and other information by species. Further, species have less significance for individual behavior than groups of species. Most anglers can only identify a small number of species. They cannot be expected to be motivated by the catch rate of species unfamiliar to them. We have aggregated the myriad of species into four groups:
  - a. biggame
  - b. smallgame
  - c. flatfish
  - d. bottomfish

The classification of the different species into the four groups is given in Table 3. All of our results are reported for these four groups of species.

Our second major modification of the NMFS Intercept survey data concerns the targeting of species. We are interested in the availability of these aggregate groups to anglers. We believe that averaging catch rates only of those anglers who target species in the particular aggregate

group provides a more accurate measure of abundance than averaging catch rates of all anglers for the species group. After all, the catch of biggame species for an angler in a small boat fishing for flatfish will not reflect the ease with which biggame species can be caught. Averaging catch only for anglers who target each species group reduces the number of observations (some times by as much as 60%) but improves the information content of the resulting catch rate estimates.

In the state sections, the data are presented graphically. The first figure in the state section (and most odd numbered figures) contains information, by fishing mode, on the catch rate of the relevant species groups for each year over the period 1980-1988. The numbers represent average catch rate for all species in the aggregate group. The data are not always available for all years, resulting in occasional gaps. The second figure (and most even numbered figures) shows the catch rate of the species groups, by mode, for each of the five waves. Because there are fewer waves than years, the number of observations associated with each data point is greater when the data is averaged by wave than by year, and hence the variance is smaller. Sometimes, averaging by wave provides the only reliable estimates.

### **The UMCP Survey**

One survey was undertaken as part of this study. This survey gathered economic data not available from either of the NMFS surveys. The UMCP survey was designed to obtain information on the distribution of trips, the costs of those trips, and other household demographic information, for anglers who went saltwater fishing during a NMFS wave.

The UMCP survey was conducted from November-December 1987 to October-November 1988. The sample frame consisted of all people who were interviewed on the Intercept survey.

A portion of the intercepted anglers were asked if they would answer phone questions on their fishing activities during the current wave. They were then called at the end of the two month period. Some portion of those called were also contacted for information in the subsequent two month wave. During the phone call, respondents were asked about all of the trips they took during the two month period. The questions for each trip included

- trip destination
- whether the trip was a day trip or overnight
- mode of fishing
- species group targeted
- specific variable costs of the fishing activities
- travel time and distance data
- type of waterbody.

The interviewer also gathered data on the individual interviewed, including

- place of residence
- income and earnings data
- boat ownership
- second home ownership.

The interviewer also asked several hypothetical valuation questions.

For purposes of recording destinations, and for subsequent analysis, we have divided the study area into 69 sites, most of which are counties within states. In some cases, counties were divided into two sites, and sometimes more than one county was aggregated into one site. The delineation of sites involved several tradeoffs. From the perspective of providing policy analysis

for specific sites, it would have been preferable to have more and smaller sites. However, we are operating under two constraints. First, the angler must be able to recall where the trip was taken and the interviewer must be able to record this, all over the phone. Second, since we wished to use the NMFS catch rate data, the 69 sites represent the minimal amount of aggregation from which we could safely proceed. The sites are listed in Table 2.

Table 4 gives the sampling effort for the UMCP Survey. Each cell in this table contains two numbers. The upper number is the number of people intercepted in that state of residence, and wave, who were subsequently called to complete the economic survey. The lower number in parentheses is the number of “second” interviews - that is the number of people who were called in this wave but had been intercepted and called in the previous wave. For example, in wave 2 in Delaware, 56 of the people intercepted in the field were called and interviewed. Of those 56, 37 were also interviewed in the following wave, as can be seen from the figure in parentheses in the subsequent cell. Hence in wave 3 in Delaware, there were 119 interviews, 82 who were intercepted by NMFS in wave 3 and 37 who were intercepted in wave 2 and called both in wave 2 and wave 3. In total, the UMCP survey completed almost 10,000 interviews. While small in comparison to the NMFS survey, this is still a substantial survey.

In the state sections, there are three tables constructed from the UMCP survey. These tables are designed to give descriptive economic information on fishing trips. Table 6 in each section gives information on day trips and Table 7 gives information on overnight trips. The information is primarily expenditure data--the amount spent on the trip's fishing activities by mode. The final table in each section gives information on the targeting of species groups by mode.

regardless of the season and is most prevalent in mid-Atlantic states. In fact, the negative trends are greatest in New York and New Jersey and diminish as one proceeds southward, with no discernable trend for Florida.

Interestingly, there are no significant trends in the average number of fishing trips per household called. This anomaly could have as an explanation that population growth in the mid-Atlantic is not bringing new sportfishermen into the population but the existing fishermen are taking more fishing trips. Neither this nor alternative explanations have yet been explored, but it is an important area for future research.

While we are constantly reminded of the enormity of our task and data problems a picture of East Coast sportfishing is emerging. For example, the annual pattern of participation rates is quite consistent in the Middle Atlantic (Figure 1). The concave pattern observed in the Middle-Atlantic however, does not carry over to the South Atlantic (Figure 2). The warmer climates show less variability in sportfishing activity throughout the year and most often experience peaks in activity in September and October instead of July and August.

General observations can already be made as the result of our efforts in standardizing and evaluating these data. We hope that these observations, along with improvements in accessing the data, will encourage others to complete the picture.

Table 1  
Telephone Sample Frame

Sample Range <sup>a</sup>	States	Years	Waves <sup>b</sup>
25 miles	New York	1980-1989	2 through 6
	New Jersey	1980-1989	2 through 6
	Delaware	1980-1989	2 through 6
	Maryland	1980-1989	2 through 6
	Virginia	1980-1989	2 through 6
	North Carolina	1980-1986	2 and 6 only
	South Carolina	1980-1989	2 and 6 only
	Georgia	1980-1989	2 and 6 only
	Florida	1980-1989	2 and 6 only
50 miles	North Carolina	1980-1986	3, 4, and 5
	North Carolina	1987-1989	2 and 6
	South Carolina	1980-1989	3, 4, and 5
	Georgia	1980-1989	3, 4, and 5
	Florida	1980-1989	3, 4, and 5
100 miles	North Carolina	1987-1989	3, 4, and 5

<sup>a</sup> The sample range refers to the distance between the coast or an estuary of the coast to the most distant county in the sample.

<sup>b</sup> The waves are occasionally referred to by number, where 2 is March-April, 3 May-June, 4 July-August, 5 September-October and 6 November-December.

Table 3

Aggregation of Species into Groups

Small Game

Striped Bass	Bluefish	Jack
Pompano	Seatrout	Bonefish
Bonito	Snook	Red Drum
Barracuda	Mackerel	

Bottomfish

Sandbar Shark	Dogfish Shark	Cat Shark
Sand Tiger Shark	Smooth Dog Shark	Carp
Catfish	Toadfish	Cod/Codfish
Pollack	Hake	Sea Robin
Sea Bass	Sawfish	Grunt
Bottomfish	Croaker/Spot	Cunner
Kingfish	Mullet	Tautog
Butterfish	Nurse Shark	Brown Cat Shark
Porgy/Scup	Sheepshead	Pinfish
Snapper	Grouper	Perch
Black Drum		

Flatfish

Summer Flounder	Winter Flounder	Southern Flounder
Sole		

Big Game

Blue shark	Tuna	Marlin
Thresher Shark	Great Hammerhead	Swordfish
Shortfin Mako Shark	Tiger Shark	White Shark
Smooth Hammerhead	Scalloped Hammer	Tarpon
Billfish	Sailfish	Dolphin
Cobia	Wahoo	

Other Fish

Herring	Eel	Skate
Puffer	Blacktip Shark	Requiem Shark
Dusky Shark	Atlantic Sharpnose	Bull Shark
Smalltail Shark		

Table 4

## Sampling Effort in the UMCP Survey

State of Residence	Wave 1	2	3	4	5	6	State Totals
Delaware	-- (22)	56 --	82 (37)	105 (62)	94 (80)	30 (78)	367 (279)
Florida	154 (121)	247 (97)	282 (179)	347 (203)	234 (253)	164 (180)	1,428 (1,033)
Georgia	36 (37)	37 (24)	33 (28)	34 (22)	49 (25)	51 (40)	240 (176)
Maryland	-- 8	41 --	119 (22)	170 (86)	50 (124)	9 (39)	389 (279)
New Jersey	-- (75)	27 --	244 (15)	330 (176)	174 (255)	92 (143)	867 (664)
New York	-- (93)	64 --	165 (39)	309 (105)	180 (212)	121 (139)	839 (588)
North Carolina	3 (96)	40 0	163 (30)	241 (120)	201 (176)	117 (154)	765 (576)
South Carolina	45 (41)	62 (19)	90 (38)	50 (68)	44 (34)	52 (31)	343 (231)
Virginia	-- (2)	27	220 (16)	180 (164)	100 (137)	2 (82)	529 (401)
WAVE TOTALS	214 (487)	601 (140)	1,398 (404)	1,766 (1,006)	1,126 (1,196)	638 (886)	5,734 (4,119)
							9,853

## **Chapter 2**

# **SPORTFISHING IN NEW YORK**

### **Activity by New York Households**

The overwhelming presence of New York City dominates the pattern of in-state marine recreational fishing by residents of the state of New York. The City is the predominant source of anglers for fishing in the Atlantic, on the south side of Long Island and in Long Island Sound on the north side of Long Island. Although there is substantial coastline in the immediate area of New York City and on Long Island, access to fishing for New York households who do not live on central or eastern Long Island is more difficult than for residents of other states. Another factor affecting fishing patterns in New York is its inclement weather. Living in the northernmost state in the study area, and hence experiencing the harshest weather, New York residents can be expected to exhibit a greater response to seasons.

The NMFS telephone survey of New York is directed towards households with telephones which are located in counties within 25 miles of the coast or major bays and estuaries. According to the 1980 Census, 4,028,600 households met this requirement, about 64 percent of the total households in the state of New York as of that census year. Because the eligible households have much greater access to marine fishing than ineligible households, they can be expected to account for more of the sportfishing activity. According to NMFS estimates, over 96 percent of in-state participants in New York marine fishing are coastal county residents. Understandably, few sportfishing from other states visit New York to fish. About 90% of participants are from in-state. In terms of numbers of sportfishing trips in New York marine

waters, between 90 and 95 percent are taken by New York coastal residents with another 1 or 2 percent taken by non-coastal county New Yorkers.

#### *Participation and Quantity of Trips by Season*

A detailed picture of fishing activity is given in Table NY.1, which provides participation rates by year and season. These rates show the kind of seasonal distribution one would expect. They are low -- between 1 and 3 percent -- for the early spring and late fall waves. The peak season is July-August, when the participation rate averages about 7 percent. The means for the five waves reflect this seasonal variation and are significantly different from one another.

The seasonal participation rates in New York demonstrate the same variability found in many other mid-Atlantic states: systematic differences across waves and considerable variation within waves. For example, in 1987 the rate increases from 1.3 percent in March-April to 4.6 percent in May-June and 7.3 percent in July-August and then declines to 2.1 percent in November-December. The variability within season is especially apparent for the March-April wave, when participation in the peak year (1980) is more than three times the rate in the low year (1987). Variability in waves encompassing May through October is notably smaller, reflecting the reduced influence of weather.

To see whether any trend in participation rates occurred over time, a linear time trend model was fitted to the participation rates for each wave. The results are presented in Table NY.2. Four of the five reported trends are negative, although only three are statistically significant at the 95% level of confidence. The trend indicates that from 1980 to 1989 participation rates from March through October were falling by about .3% per year. The highest estimated rate of decline was during the July through October period and the least was during

the May/June wave. Over the ten year period, a .3% annual fall amounts to about a 3% overall decline.

The participation rate measures the prevalence of the fishing activity over households called, but it gives no indication of the magnitude of the activity. The magnitude is reasonably measured by the total level of trips. This can be calculated by multiplying the number of fishing households by the number of trips per fishing household. The same measure can be calculated by multiplying the number of trips per household called by the number of households called.

Table NY.3 gives the number of trips per household called. The same temporal variation can be seen in trips as was evident in participation. Trips in the dominant wave (July-August) peak in 1981, 1984 and 1987. Annual total trips display a different pattern, peaking in 1983 and declining thereafter.

A sense of the seasonal variation can be derived by computing the proportion of mean annual trips taken in each wave. The mean trips per household called using all eight years of data are distributed as follows:

	<u>Mean Trips</u>	<u>Percent of Annual Mean</u>
March-April	.11	9.0
May-June	.31	26.3
July-August	.47	39.8
September-October	.22	18.6
November-December	.07	5.9

Between 80 and 90 percent of the annual activity occurs in the six-month period from May through October.

Linear trend analysis indicated no significant trends on any of the five waves. This information, combined with the negative trend in participation rate, points to an increased number of trips per participant. That is, trips per household called is computed as the product of (participants/household called) (trips/participant). If the participation rate is falling and there is no trend in trips per household called, the number of trips per participant must be rising over time. Likely, the occasional fisherman is no longer fishing and, perhaps, the frequent fisherman is taking more trips.

#### *Sportfishing Activity by Mode*

Compared to residents in other middle and south Atlantic states, access to sportfishing for New York households is quite difficult. The greater New York area is highly developed, making the shoreline less accessible. Table NY.4 shows the distribution of fishing trips among the three different modes. These proportions are means for the period 1981 to 1988.

The proportion of fishing trips from shore is roughly constant for the first four waves, and then increases in the November-December wave. This increase in proportion reflects the decline in the use of private boats during the months of poor weather for boating. The proportion who use the party/charter mode is highest during off-season months. Party/charter use is quite high relative to other states, probably due to the limited shore access available to the public in the New York area. Long Island provides substantial shoreline, much of it is held privately. Public access becomes prevalent only as the distance from the population center declines. Hence, a larger portion of the demand for marine sportfishing is met through private services in the form of party/charter boats.

To get some insight into the magnitude of fishing by mode, we must expand the trips per household called to the total population of eligible households. Table NY.3 gives means of trips per household called by wave, averaged over the decade. For the 1980 Census, there were an estimated 4,028,600 households eligible to be called. For March-April, the mean trips per household called was .11. Hence for eligible New York households, one would predict 443,146 ( $= .11 * 4,028,600$ ) trips as annual average for March-April. Table NY.4 shows the distribution of these trips. It suggests that there were in the order of 256,138 private/rental boat trips in March-April. The proportion of private/rental boat trips is almost the same in July-August (56.6 percent), but the aggregate level of trips for this wave is 1,893,442 ( $= .47 * 4,028,600$ ). Hence the predicted level of private boat trips for the wave rises to over a million - 1,071,688. Despite the relative constancy of the proportion of private/rental trips from March-April to July-August, there is a substantial increase in the number. The proportion of trips on the party/charter mode declines from about 22 percent in March-April to about 11 percent in May-June, and then rises to a bit more than 15 percent for the remainder of the year. But the magnitude of the changes is quite different from the proportions. The level of party/charter trips in March-April is predicted as 97,935, and this level rose to 217,746 in May-June. The seasonal variation in the party/charter fishing has substantial impact because it is a market activity and implies a considerable variation in the employment of party/charter services.

#### *Sportfishing Activity by Waterbody*

Table NY.5 gives details of the distribution of fishing trips by wave and waterbody. The principal waterbodies for marine sportfishing in New York are the Atlantic beaches, Long Island Sound, the small enclosed bays of Long Island, and the Hudson River. These waterbodies

correspond fairly well with subgroups of the NMFS categories: ocean, gulf, open bay, sound, river, enclosed bay, other, and mixed.

About half of the fishing is in the first category--ocean, gulf, and open bay. This means fishing south of Long Island. An additional 15 to 30 percent of trips occurs in sounds, which includes only Long Island Sound for New York. Fishing in enclosed bays is about 15 percent to 20 percent. In November and December, fishing in rivers jumps from an insignificant level to over 20 percent.

The predicted number of trips for the relevant population by wave and waterbody is calculated analogous to the wave and mode estimates. For March-April, the 443,146 trips are apportioned according to Table NY.5. The trips to ocean, bay, and open gulf increase greatly from March-April to July-August. In March-April, there were 222,459 trips to this type of waterbody, and this increased to over a million in July-August (1,022,459).

### **Catch Rates in New York Waters**

Saltwater angling off New York's coast takes place largely in the Ocean, in Long Island and Block Island Sounds, and in Peconic and Gardiners Bays (on the eastern tip of the Island). Species caught in these areas vary as do the size/age of specimens of the same species. When considering waterbody, data presented are for Sound and Ocean fishing because there are not sufficient intercepts in the bays to produce reliable catch rates.

At sites in New York, most anglers are targeting species. Prior to 1985, only 13 percent of the intercepted anglers stated they were not seeking a species and the percent has fallen to 6 percent in the subsequent years. The predominant target of the anglers is flatfish, with 45 percent of the pre-1985 intercepts and 53 percent of the post-1984 intercepts seeking flatfish.

The next most common target is smallgame, representing about 30 percent in the early period and 25 percent in the latter period. Bottomfish were the target of between 10 and 15 percent of the anglers. Finally, only between 1 and 2 percent of the anglers targeted big game.

#### *Smallgame Catch Rates*

In New York, smallgame anglers target and catch bluefish, striped bass, mackerel, and weakfish, primarily. The relative importance of the three species has remained constant over the past ten years. Bluefish represent about eighty percent of the catch of anglers targeting smallgame whereas striped bass represent about ten percent and mackerel and weakfish about five percent each.

The trend in the catch rates of smallgame species for different fishing modes and areas is presented in Figure NY1. The four trends do not show a consistent pattern, although all four exhibit a sharp decline in 1988. The one consistent element in the figure is the relative ranking of catch rates across modes. Shore fishermen have almost always experienced the lowest catch rates and party/charter, the highest.

Catch rates during the year vary depending on both the mode of fishing and the water body fished (Figures NY2 and NY3). Shore fishermen tend to enjoy the highest catch rates in July and August and the lowest in November and December. Party/charter fishermen, however, have their highest average catches during the spring and early winter. On the other hand, catch rates for private boat fishermen fall during the year in Long Island Sound whereas they generally increase over the year in the Ocean.

### *Bottomfish Catch Rates*

During the first half of the decade, the principal species of targeted bottomfish was tautog, representing about thirty percent of the anglers targeting bottomfish. Since the beginning of 1985, the importance of tautog has grown by two-thirds, so that fifty percent of all anglers targeting bottomfish are seeking tautog. Before 1985 Atlantic cod was an important bottomfish species, accounting for about twenty-five percent of the bottomfish anglers, but since 1985 cod's share has dropped to fifteen percent.

Scup has been targeted by a constant twenty-five percent of the bottomfish anglers. Porgies, prevalent prior to 1985, are rarely targeted and caught now. About five percent of the targeted catch is now black sea bass, a species which was not targeted and caught prior to 1985.

Unlike the small game situation, the catch rate of targeting fishermen on party/charter boats has been consistently lower than on private boats (Figure NY4). Bottomfish caught by private boat fishermen, both in the Sound and Ocean, appear to have been more abundant in the early and late eighties than during the mid-eighties. There is no similar pattern for party/charter fishing.

### *Flatfish Catch Rates*

There are two primary species of flatfish targeted in New York waters, summer and winter flounder. Prior to 1985, 40 percent of the people targeting flatfish were seeking summer flounder and the remaining 60 percent were seeking winter flounder. In the latter part of the eighties, those targeting summer flounder showed a moderate 5 percent increase.

Flatfish catch rates in the Atlantic Ocean also exhibit the unusual characteristic that fishermen from private boats on average catch more than those on party/charter boats (Figure

NY5). The ocean party/charter fisherman's catch rate, however, is generally higher than the ocean shore fisherman. Over the ten year period, the private/rental fisherman averaged about 5 fish/person/day, the shore fisherman about one and one-half fish, and the party charter fisherman about four. The level of catch rates in Long Island Sound were quite similar to those in the Ocean.

Although it is not easy to discern a time trend in the figure, the catch rates prior to 1984 were, on average, lower than those after 1984 for every mode of fishing. The low period seems to cover the years 1982/1983. Uniformly good fishing began in the 1984/1985 period and has remained strong for most modes of fishing since then.

Flatfishing varies across seasons. Peak catch rates for flatfish occur in the early and later parts of the year, with the November/December period exhibiting the highest catch rates for nearly every mode (Figure NY6). The worst catch rates appear uniformly in the September/October period.

### **Characteristics of Fishing Trips in New York**

The previous descriptions pertain to aggregate fishing activity and the biological characteristics of fishing in New York. They were distilled from the two NMFS surveys for the years 1981-1988. We can consider other demographic data on the characteristics of fishing trips. These data, from the 1988-1989 telephone survey of households, help us understand what individual fishing trips are like.

Table NY.6 describes day trips taken in New York, by mode. There are six modes recorded in the UMCP survey: the shore modes are beach and pier; the boat modes are party, charter, private, and rental. Travel costs are highest for charter and rental, reflecting the fact

that people from further away take relatively more charter and rental trips. Bait costs are quite high compared to other states. The low bait costs for party boats probably reflect the nature of the party contract; bait is part of the price of admission. Bait costs are especially high for the rental and private modes. Tackle costs are similar for the three private modes: pier, beach, and private boat. They are lower for the hired-boat modes, where some part of the tackle costs may be included in the contract. Except for the rental mode, the travel costs and time are similar.

Table NY.7 describes fishing trips which are taken as part of overnight visits to New York. These trips are too few to disaggregate by mode. The overnight visits can be motivated by many factors, including vacations, business trips and visits to relatives. The travel cost is similar to the day trip travel cost for public modes. The tackle and cleaning costs are comparable to the day trips' costs. The bait cost is quite high, but not completely out of line with the bait cost for the day trips.

Table NY.8 shows the distribution of species sought by mode. The importance of flatfish stands out in this table, reflecting the relative importance of the summer and winter flounder fishing. In four of the six modes, it is the most important species. The rental sector is quite large in New York, relative to other states. This table shows the importance of flatfish for the rental sector. Fishing for big game is feasible only on the eastern tip of Long Island, and only a small proportion of trips are targeted at big game species.

Table NY.1

Two-Month Participation Rates\*  
by Wave and Year

Year	Wave				
	March- April	May- June	July- August	September- October	November- December
1980	4.4%	4.7%	8.9%	6.1%	1.1%
1981	3.7	6.5	10.8	5.4	1.6
1982	3.0	6.7	6.9	4.3	1.8
1983	3.1	6.5	7.9	4.5	1.2
1984	3.0	5.4	7.5	4.4	1.0
1985	2.7	4.8	4.9	4.2	2.7
1986	3.4	5.3	8.9	5.2	2.1
1987	1.3	4.6	7.3	4.1	2.1
1988	2.1	4.9	5.2	3.6	1.7
1989	1.4	3.7	7.6	2.0	1.3
Mean	2.8%	5.3%	7.6%	4.4%	1.7%

\* Percent of New York coastal county households called who indicated they fished in New York marine waters in the previous two months.

Table NY.2  
 Linear Trend Analysis<sup>1</sup> New York Participation Rates,  
 By Wave, 1980-1989

	Constant	Linear Coefficient	$\bar{R}^2$
March/April	.041 (13.29)	-.0027 (-4.87)	.72
May/June	.063 (13.50)	-.0021 (-2.43)	.35
July/August	.089 (9.54)	-.0029 (-1.68)	.17
September/October	.057 (13.87)	-.0029 (-3.82)	.60
November/December	.014 (4.47)	.0006 (.085)	.00

<sup>1</sup> Estimated model was Part. rate =  $\alpha_0 + \alpha_1$  time, with time defined as t = 0 for 1980. t = 1 for 1981 . . . and t = 9 for 1989.

<sup>2</sup> T-ratio in parentheses.

Table NY.3  
Trips Per Household Called  
By Year and Season\*

Year	Total	Wave				
		March- April	May- June	July- August	September- October	November- December
1980	-- %	.06%	--%	--%	--%	.03%
1981	1.01	.08	.23	.44	.23	.03
1982	1.01	.07	.27	.43	.19	.04
1983	1.52	.11	.62	.55	.21	.03
1984	1.47	.12	.36	.67	.26	.03
1985	1.18	.23	.28	.22	.25	.19
1986	1.19	.10	.25	.43	.32	.10
1987	1.15	.04	.32	.52	.22	.06
1988	1.18	.16	.31	.43	.20	.07
1989	.94	.04	.17	.54	.12	.07
Mean	1.18	.11	.31	.47	.22	.07

\* trips taken within state of residence.

Table NY.4  
Percent of Fishing Trips in Various Modes by Wave  
Mean 1980-1988

Mode	Wave				
	March- April	May- June	July- August	September- October	November- December
Shore	26.1%	31.6%	27.9%	28.1%	42.6%
Party/Charter	22.1	11.5	15.5	17.6	18.7
Private/Rental	57.8	57.0	56.6	54.3	38.7

Table NY.5

Percent Fishing Households Who Fish in Various Areas, by Wave  
Mean 1980-1988

Area	Wave				
	March- April	May- June	July- August	September- October	November- December
Ocean, Gulf, Open Bay	50.2%	44.8%	54.0%	53.2%	48.2%
Sound	32.1	30.1	21.4	28.5	14.5
River	1.6	2.3	1.7	1.3	22.7
Enclosed Bay	15.0	21.9	22.5	16.9	14.4

Table NY.6

Average Characteristics of Day Trips in New York, by Mode  
(per trip averages)

Characteristic	Mode					
	Pier	Beach	Party	Charter	Rental	Private
Travel Cost	\$ 5.78	\$ 5.30	\$ 8.73	\$16.16	\$17.24	\$9.10
Costs for						
Bait	5.58	3.89	1.53	4.17	12.26	9.78
Tackle	3.48	4.07	1.19	.65	1.93	3.88
Cleaning	.58	.51	2.04	1.87	1.33	2.38
Fuel	--	--	--	--	3.47	19.24
Pier Fees	.67	--	--	--	--	--
Boat Fees <sup>a</sup>	--	--	29.86	37.03	41.96	--
Travel Time (in minutes)	30.9	32.0	42.4	44.2	69.1	32.77
Distance (in miles)	21.1	19.6	29.2	32.5	50.5	20.40
Boat Time to first site (in minutes)	--	--	52.5	65.1	21.5	31.3
Number of Observations	149	95	318	85	64	579

<sup>a</sup> Boat fees are charter and party fees or rental fees.

Table NY.7

## Characteristics of Trips for Overnight Visits in New York

Characteristic	Mean	Number of Applicable Observations
Travel Cost	\$6.87	143
Cost for		
Bait	17.99	147
Tackle	3.94	149
Cleaning	3.38	149
Fuel	42.15	73
Pier Fees	.87	12
Boat Fees	47.76	36
Boat Rental	<sup>a</sup>	<sup>a</sup>
Travel Time (in minutes)	10.9	136
Distance (one-way) (in miles)	6.4	143
Boat Time (in minutes)	72.4	110
Trip Length (in miles)	6.0	151

<sup>a</sup> Only one observation for boat rental

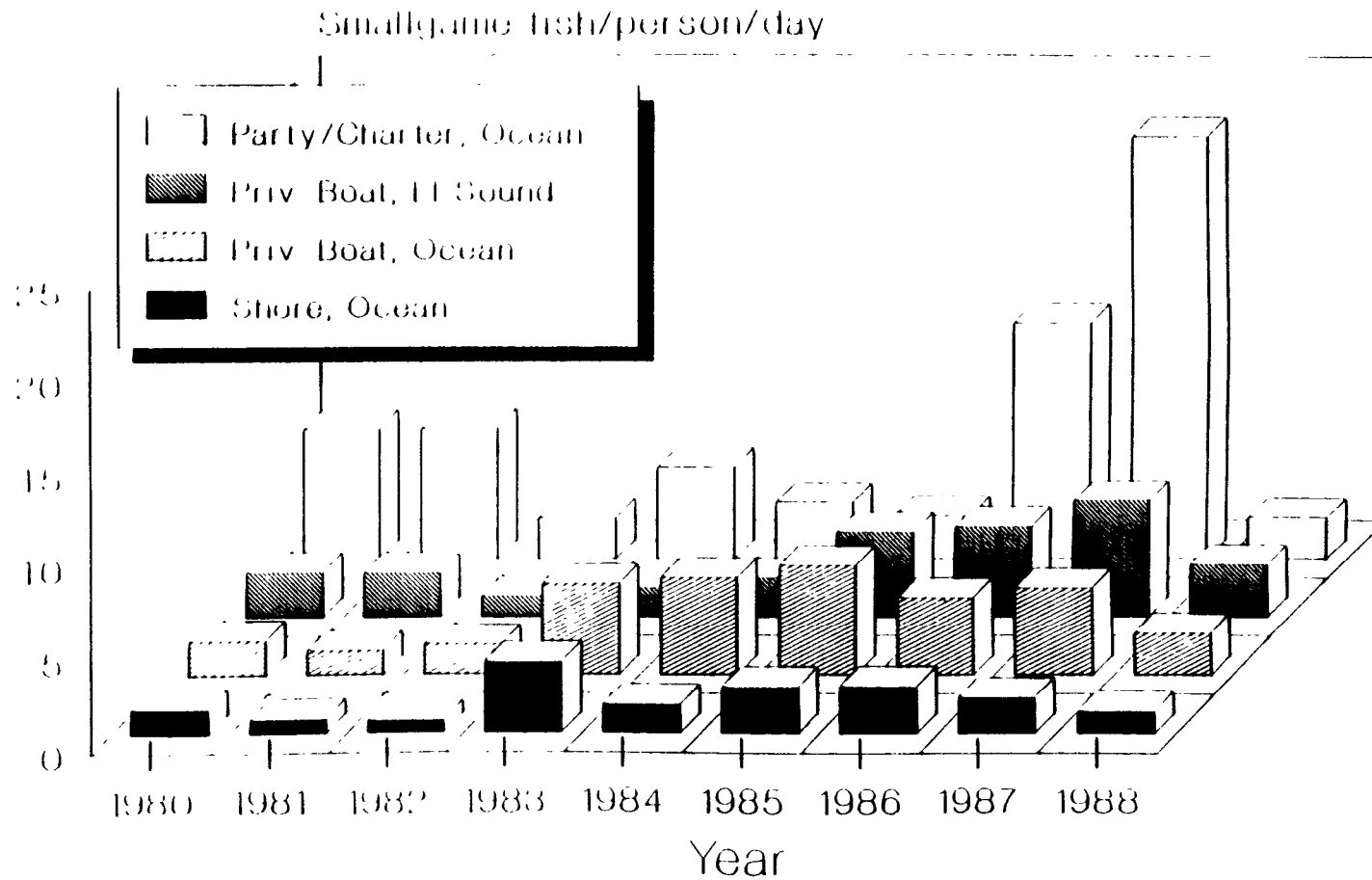
Table NY.8

Percent of Trips Seeking Different Species Groups, by Mode  
for Day Trips

Species Group	Mode					
	Pier	Beach	Party	Charter	Rental	Private
Big Game	.8	0.0	2.9	18.8	3.3	12.2
Small Game	26.2	66.7	23.2	35.0	11.5	37.2
Flatfish	62.3	24.1	37.9	30.0	80.3	41.7
Bottomfish	9.8	9.2	36.0	16.3	4.9	8.7

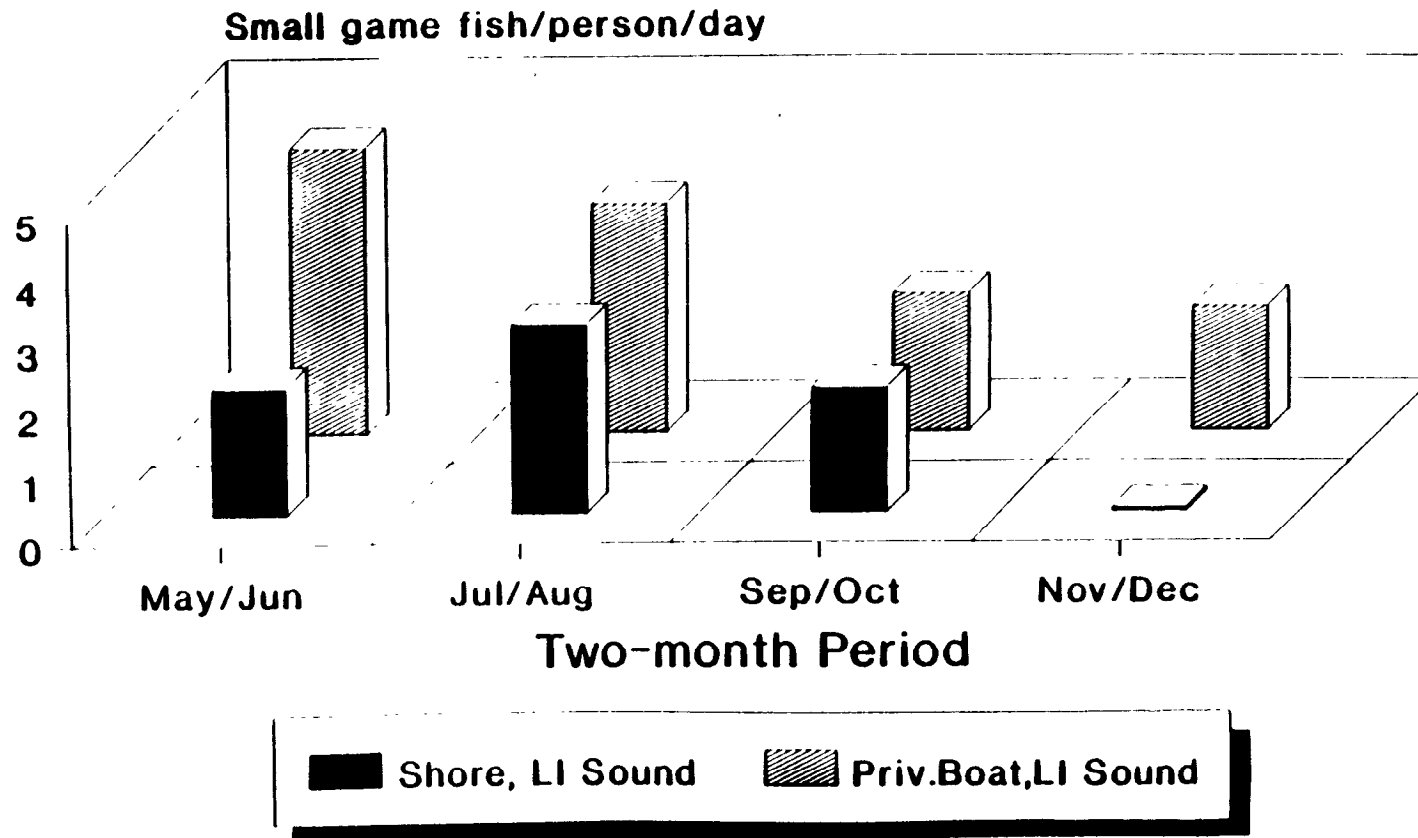
rfishny.wp/lt/8-21-91

**Fig. NY1: Smallgame Catch Per Day,  
New York, Long Island Sound and Ocean,  
By Fishing Mode, 1980-1988**



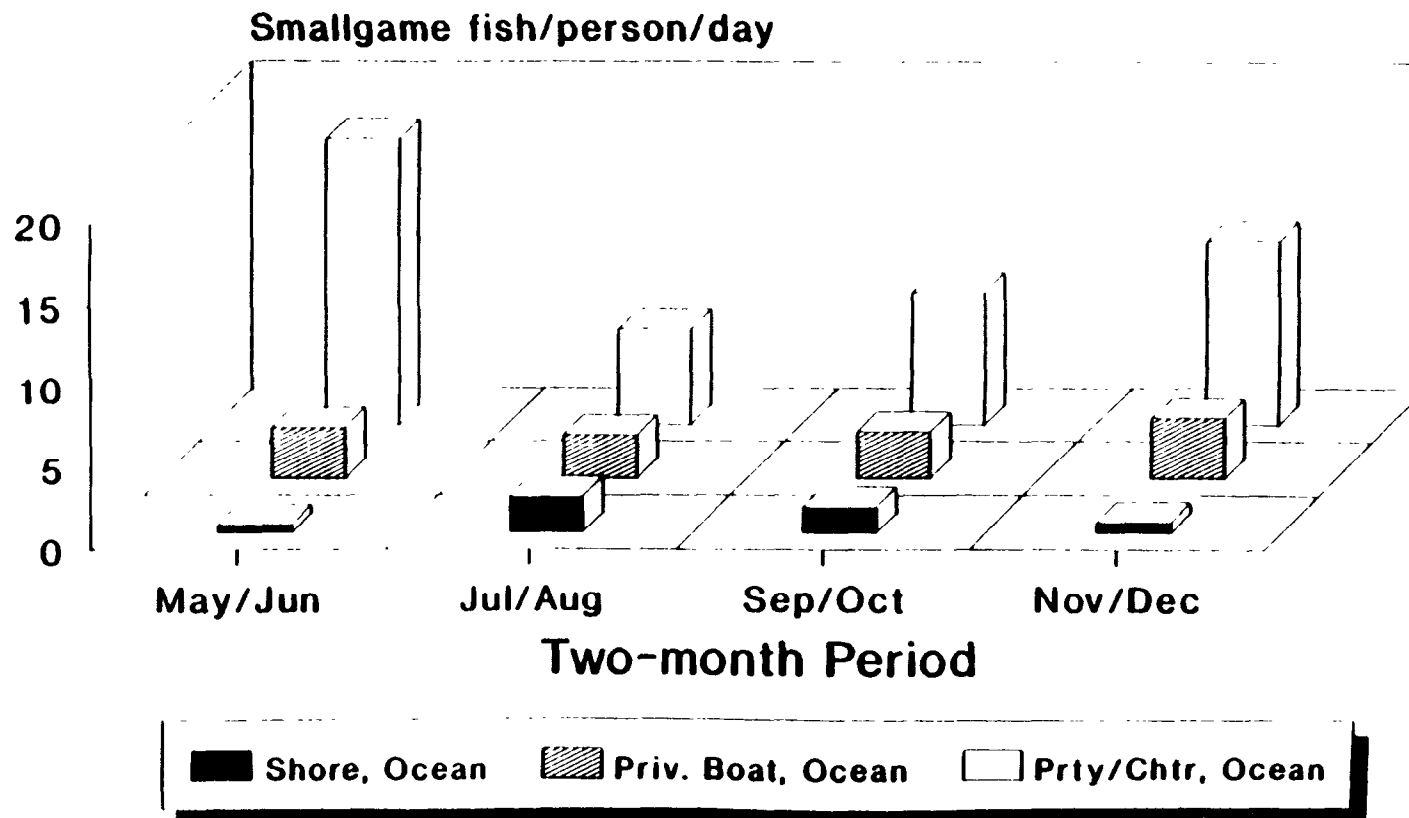
For individuals targeting smallgame:

**Fig. NY2: Small Game Catch Per Day,  
New York, Long Island Sound,  
By Wave and Mode**



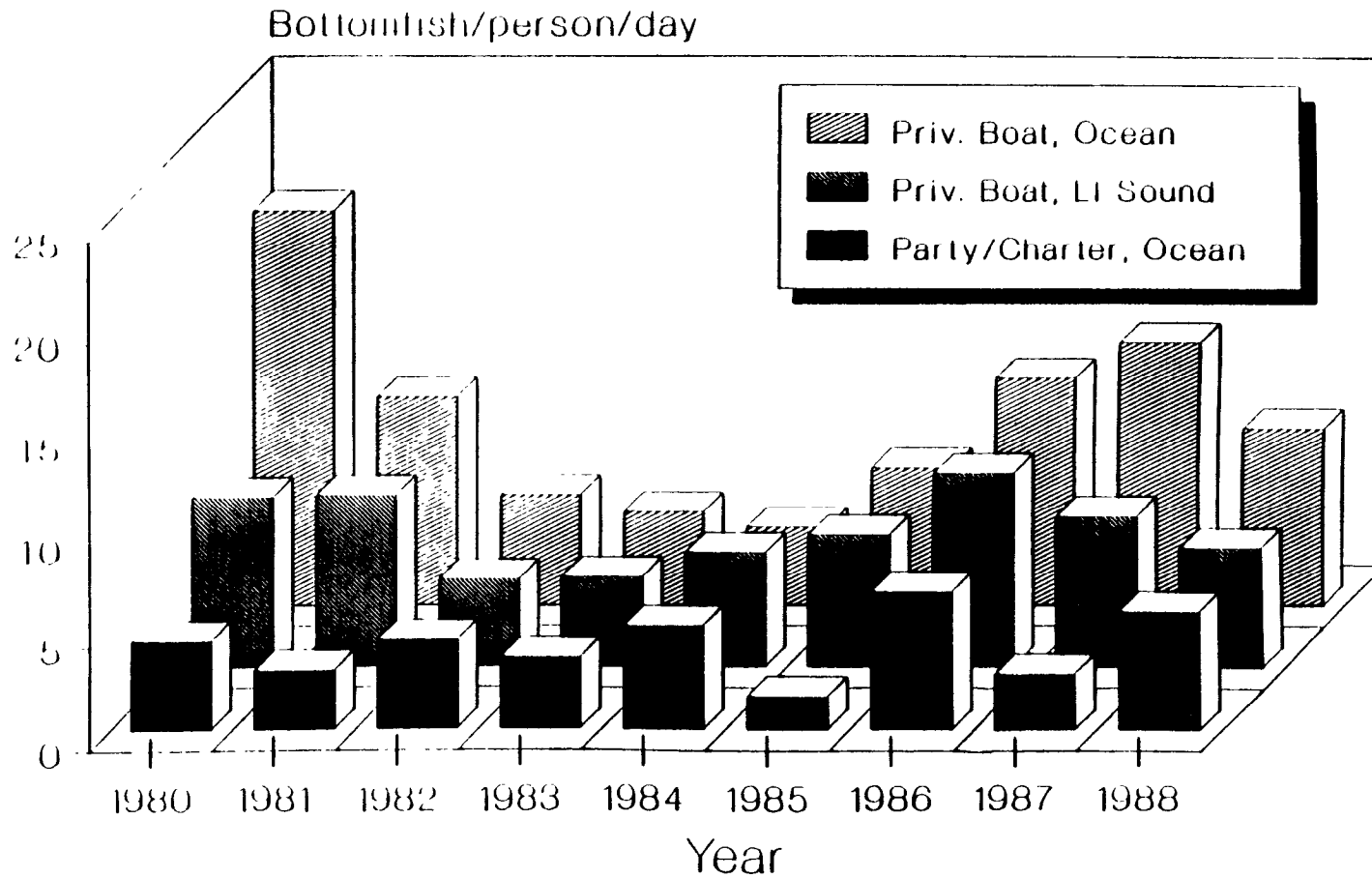
Average for individuals targeting small  
game, 1980-1988.

**Fig. NY3: Small Game Catch Per Day,  
New York, Atlantic Ocean,  
By Wave and Mode**



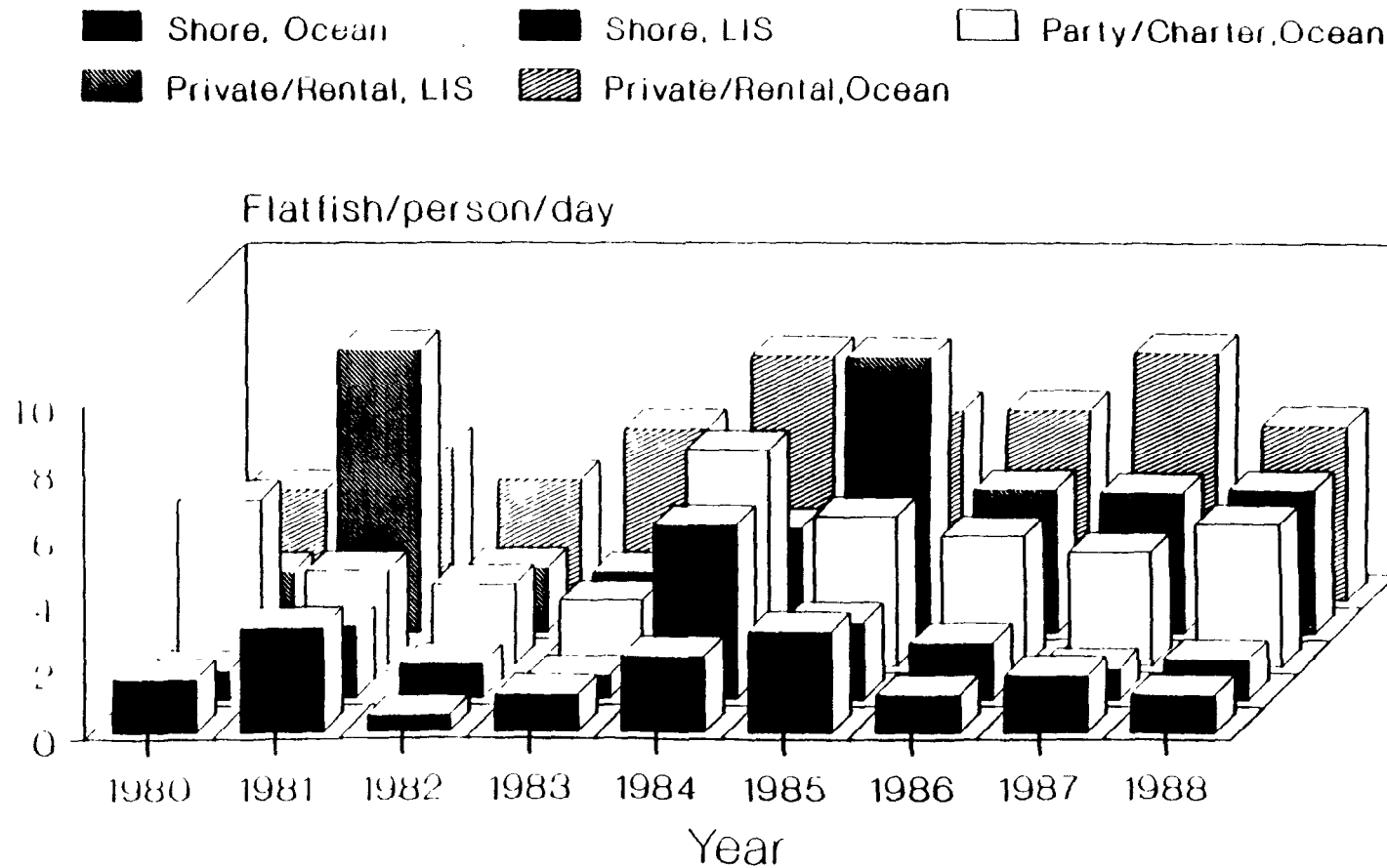
Average for individuals targeting small  
game, 1980-1988.

**Fig. NY4: Bottomfish Catch Per Day,  
New York, Ocean and Long Island Sound  
By Fishing Mode, 1980-1988**



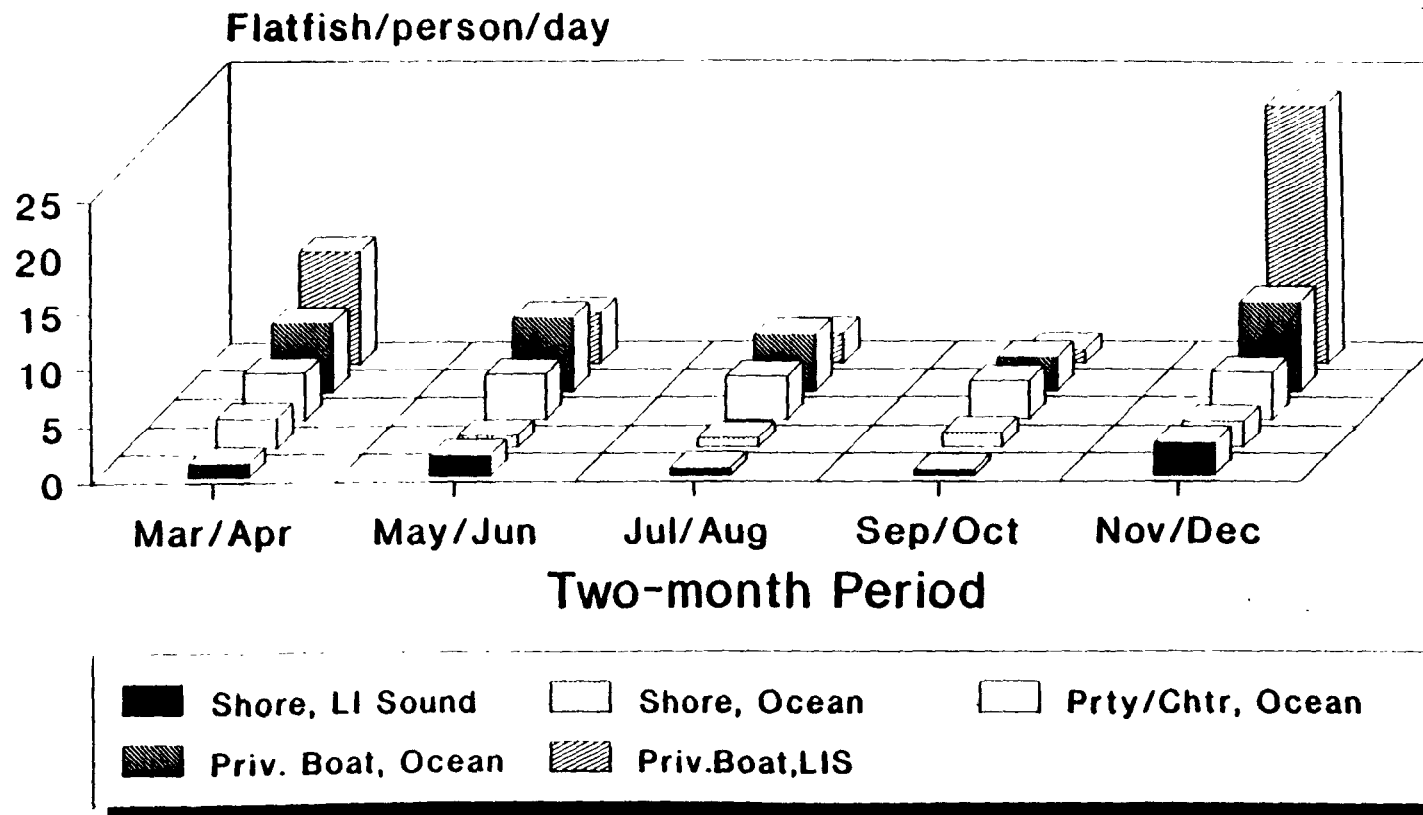
For individual, targeting bottomfish

**Fig. NY5: Flatfish Catch Per Day,  
New York, Ocean and Long Island Sound,  
By Fishing Mode, 1980-1988**



For individuals targeting flatfish

**Fig. NY6: Flatfish Catch Per Day,  
New York, Atlantic Ocean,  
By Wave and Mode**



Average for individuals targeting  
flatfish, 1980-1988.

## **Chapter 3**

### **SPORTFISHING IN NEW JERSEY**

#### **Activity by New Jersey Households**

The New Jersey coast stretches from the heavily populated suburbs of New York City to the north, past the New York barrier islands, around the tip of Cape May to the mouth of the Delaware Bay. The coast provides quite a variety of types of waterbodies for fishing. The climate is inhospitable for fishing from late fall through early spring. But there is a large population of potential fishermen living relatively close to the New Jersey shore. Many of these potential users are residents of other states, in particular those living in New York City and in Philadelphia.

Unfortunately, NMFS telephone data does not permit consideration of out-of-state users. The NMFS telephone survey of New Jersey is directed toward households who live in counties within 25 miles of the coast or of major bays or estuaries, for all waves, March through December. According to the 1980 Census this includes 2,478,500 households. In the first half of the decade, between 55 and 65 percent of the participants in New Jersey marine waters were from in-state coastal counties. But that percentage appears to have dropped to about 40 percent in later years. Over the years about two-thirds of the sportfishing trips to New Jersey waters were taken by these coastal county residents. Almost all of the remaining Participation and trips are attributable to out-of-state residents.

*Sportfishing Activity: Household Participation Rates and Quantity of Fishing Trips*

Results of the telephone survey give a detailed picture of the seasonal and temporal variation in sportfishing by New Jersey households. Table NJ.1 gives participation rates by wave and year for the ten years from 1980 through 1989. The participation rates show the percent of households called in a wave that fished during the designated two months. These rates show the dispersion of fishing activity over the population of households, not the magnitude. Although the rates are larger in New York, they show similar seasonal patterns. In early spring and late fall -- March-April and November-December, participation rates are quite low, varying from 1.0 percent in March-April, 1989 to 4.7 percent in March-April, 1986. The mid-summer wave of July-August has a relatively high rate, averaging about 10 percent. The sample sizes for these waves vary from a low of 568 to a high of 4988, but all samples are large enough to give confidence in the participation rate estimates.

The participation rates by wave and year show considerable variation within and among seasons. The seasonality is obvious from the means. The rate in July-August is more than three times the rate in early spring or late fall. Consider 1987. The number of households who sportfish increased four-fold from March-April to July-August. Within season variability is not as great as with other states. November-December shows the greatest proportional variation, probably due to weather systems moving up the coast.

There is evidence of trend, depending on the wave (Table NJ.2). In all waves, the trend coefficient is negative and it is statistically significant in the March-April and July-August wave. The July-August pattern is particularly pronounced, with an average annual decline of .7%. This means that by the end of the ten-year period, nearly 7% less of the population was participating

in marine angling. This could be the result of many factors, including differing preferences of the new additions to New Jersey's population, the changing fish populations, or increasing costs of fishing.

The magnitude of sportfishing is better expressed in number of trips than in participation rates. Table NJ.3 shows trips per household called by wave and year over the period of the telephone survey. These measures can be used to calculate aggregate trips simply by multiplying trips per household called by the number of eligible households. (Aggregate trips could also be calculated by the product of trips per fishing household, the proportion of fishing households, and the number of eligible households.) Using all eight years of data, we can compute the proportion of trips taken in each season as follows:

	<u>Mean Trips</u>	<u>Percent of Annual Trips</u>
March-April	.09	5.8
May-June	.35	22.6
July-August	.67	43.2
September-October	.33	21.3
November-December	.11	7.1

Over 85 percent of the trips by coastal residents of New Jersey are taken in the period May through October. And in the peak summer wave, July-August, 43 percent of the sportfishing activity occurs.

There is more variability within and among seasons in the trips data than in the participation rate data. For example, the trips in March-April more than double from a low of .04 per household called in 1989 to a high of .15 in 1983. In the July-August wave, the range

is from .30 to .88. This shows great variability, with activity levels being reduced by more than 50 percent from one year to the next.

As with the New York data, there were no statistically significant time trends in the number of trips per household called. This, continued with the failing participation rate, implies an increasing number of trips per participant. Thus, the infrequent participant is likely to have stopped participating whereas the frequent participant likely increased marine fishing.

#### *Sportfishing Activity by Mode*

The data in Tables NJ.1-3 are quite superficial, revealing little about the nature of the fishing activity. A better sense of fishing activity comes from knowing something about the household's fishing activities. Table NJ.4 gives the distribution of fishing trips by the three primary modes. These proportions are means for the years 1981 through 1988. They show the impact of seasonality on the kinds of fishing, as well as the basic structure of the fishery. Shore fishing and private/rental boat fishing are inversely proportional. Shore fishing is more popular in early spring and late fall. The proportion of fishing trips in the private/rental mode peaks at about 60 percent in July-August. The proportion of trips in the party/charter mode, about 12 to 20 percent over the year, is quite high relative to other states.

Table NJ.4 provides information on the distribution of trips over modes and seasons. To gain some appreciation of the magnitudes, we can use information on the number of households who live in coastal counties and the number of trips per household called in Table NJ.3. By the 1980 census, 2,478,500 households lived in the coastal counties of New Jersey. Table NJ.3 shows mean trips per household called for March-April to be .09. Aggregate trips for coastal county residents would be 223,065 ( $=.1 * 2,478,500$ ). From Table NJ.4, 20.5 percent or

45,728 of these trips would be attributed to the party/charter mode. In July-August, there were .67 trips per household called, implying 1,660,595 total trips by coastal county residents. Of these an estimated 12.9 percent or 214,217 trips were party/charter trips. This level of party/charter trips requires a considerable infrastructure to support the production of services. Thus calculations do not consider people who fish in New Jersey who are not coastal county residents. About two thirds of all trips in New Jersey are taken by coastal county residents.

#### *Sportfishing Activity by Waterbody*

The nature of sportfishing in New Jersey is also characterized by the kinds of waterbodies in which people fish. The telephone survey asked households about fishing in four types of water: ocean, gulf and open bay; sound; river; and enclosed bay. Table NJ.5 shows the proportion of fishing trips in each type of waterbody by season. This table gives the mean proportions for the eight year sample period. As is true for other states, the waterbodies are ambiguous. But they show some of the seasonality in the sportfishery.

In New Jersey, the principal fishing areas are the Atlantic and the bays and estuaries protected by barrier islands. Households responses overwhelming favor the ocean, gulf and open bay alternative. The proportion of trips to this type of waterbody rises over the year from about 70 percent to almost 90 percent in the fall. The high rate in the fall may be in response to the fall migration of bluefish. Enclosed bay is the second most popular area in all but the early spring wave and late fall wave when a larger portion of the fishing trips are taken in rivers.

Aggregate trips for different waterbodies can be computed just as for different modes. Of the 223,065 estimated trips on average in March-April, 74.3 percent or 165,737 would be attributed to ocean, gulf, or open bay waters.

### **Catch Rates in New Jersey**

New Jersey's long shoreline on the Atlantic plus two large bays at its northern and southern extremities deserve special attention. Raritan Bay lies at the north, being a portion of the entrance to New York harbor, and the southern boundary of New Jersey is the Delaware Bay. We chose to consider the catch rates for sites adjacent to the ocean and for the sites adjacent to the two Bays. Unfortunately there was insufficient data to consider the Delaware Bay independently.

The percentage of anglers intercepted in New Jersey who did not target species is larger than in New York, rising from 18 percent in years prior to 1985 to 20 percent in subsequent years. However, like New York, flatfish are the most targeted species. About 42 percent of New Jersey's anglers target flatfish, regardless of the period. Smallgame were the next most targeted species, with 26 percent of the anglers prior to 1985 and 33 percent in subsequent years. The targeting of bottomfish fell from 12 percent to 6 percent over the periods. Finally, biggame is targeted by less than 1 percent of the anglers.

#### *Smallgame Catch Rates*

The predominant species of smallgame targeted from New Jersey sites are bluefish, striped bass, weakfish and Atlantic mackerel. Weakfish and Atlantic mackerel were targeted by about 20% and 5%, respectively, of smallgame anglers over both the pre- and post-1985 period. Prior to 1985, striped bass and bluefish were targeted by about 10% and 65% of smallgame

anglers, respectively. This percentage changed in the 1985 and later period to about 5% for striped bass and 70% for bluefish.

Figure NJ1 shows the catch rate of smallgame by site and year for people targeting smallgame. There is remarkable consistency in these catch rates over modes, particularly over the party/charter and the private boat mode. In general, the figure gives the impression of high catch rates in the mid-eighties (1983-1986) and much lower catch rates at the beginning and end of the decade. The 1982 values are low, similar to the dip experienced in New York in this year. The values of the catch rates suggest that the shore mode is the least effective, experiencing approximately one-third the catch rate of party/charter fishers and one-half the rate of the private boat anglers.

Catch rates for smallgame in counties bordering the ocean vary dramatically over the year (Figure NJ2). Those individuals who brave the colder weather and use party/charter modes of fishing in March/April or November/December tend to have more success than those fishing at other times. The shore mode yields high catch rates in the March/April period but is not as productive in the winter. Finally, the private boat catch rates are high in the summer months and in November/December. No one targeting smallgame was interviewed in the private boat mode during March/April.

Although there were not sufficient data from sites on Raritan Bay to study trends in smallgame catch rates over the decade, there were sufficient data to observe seasonal variation (Figure NJ3). No one who was targeting smallgame was intercepted at these sites in March/April. The remainder of the year shows substantial variation across seasons and mode of fishing. The peak catch rate of smallgame for private boat fishing is May/June, the peak wave

for shore fishing is July/August and for party/charter fishing it is September/October. The highest catch rates are obtained by the party/charter mode.

#### *Bottomfish Catch Rates*

Popularity of targeted bottomfish in New Jersey waters has varied over the decade. The first five years saw anglers targeting silver hake (28%), tautog (26%), black sea bass (18%) and red hake (15%). In the latter half of the eighties, silver hake was not as frequently targeted while the other three species increased in popularity. During the latter period, tautog (38%) has been the dominant species, with black sea bass (23%) and red hake as the other popular species.

Not as many anglers target bottomfish and thus the data are not as abundant nor as meaningful. However, there were sufficient fishermen intercepted to examine the catch rates from ocean sites for shore fishermen and party/charter fishermen.

Figure NJ4 shows how the catch rates have changed over the eighties. For shore fishermen, the beginning of the eighties offered poor catch rates for bottomfish, whereas the mid-eighties offered better fishing. There was a drop-off in 1986 followed by a steady rise for the remaining period. Party/charter fishing showed more of a steady progression of improving fishing from 1980 to 1985, followed by the same drop in catch rate in 1986. An upward swing is also observed since 1986.

Seasonal variation in bottomfish catch rate is evident from Figure NJ5. For the party/charter boats, fishing begins in March/April with low catch which increases to a high in September/October. November and December also offer a reasonably high catch rate. Shore fishermen first appear targeting bottomfish in May/June, and catch rates rise in September/October and fall in November/December.

### *Flatfish Catch Rates*

As in New York, the predominant flatfish targets are summer and winter flounder. However, the summer flounder is the most popular flatfish in New Jersey, sought by 78% of the targeting flatfish anglers in the pre-1985 period and 83% in the 1985-1988 period. The percentage of anglers targeting flatfish who seek winter flounder has fallen from 19% in the pre-1985 period to 14% in the 1985-88 period.

Catch rates of flatfish from ocean sites (Figure NJ6) reflect poor fishing in 1982, a pattern also apparent in New York data. The general trend in shore catch rates is downward over the decade, but there is not much evidence of a trend in catch rates from private boats. If anything, the middle of the decade showed higher catches for private boat fishermen.

On Raritan Bay sites (Figure NJ7), the lowest catch rate was experienced by party/charter fishermen in 1983 and the highest by private boat fishermen in 1985. The final three years (1986-1988) show relatively constant catch rates, similar to the New Jersey ocean and the New York ocean/sound patterns.

The seasonal variation in catch rates is also similar to New York's. The largest catch per day often occurs either in the March/April period or the November/December period (Figure NJ8). The November/December period is most important for the ocean sites, and the March/April period shows high catch for the Raritan Bay sites. The worst period for the ocean sites appears to be July/August.

### **Characteristics of Fishing Trips in New Jersey**

The economic aspects of fishing trip pertain to costs of travel and services as well as the catch rates and destinations of trips. The UMCP survey of anglers gives some of the important economic characteristics of trips taken to fishing spots in New Jersey in 1988, but which may originate anywhere. The following section describes some of these data.

Table NJ.6 characterizes one day trips taken to New Jersey sites for marine sportfishing by mode. There are six modes: pier and other artificial structure, beach, party boat, charter boat, rental boat and private boat. Each mode is reasonably well represented for New Jersey. The travel costs are lowest for the beach trips, because fishing sites on beaches are more broadly dispersed than other modes. The rental mode has the highest travel cost. The bait costs for the charter mode are quite high, suggesting that some of these costs are not included in the fee for boat and other services. Cleaning fees for pier and beach fishing are lower than for private and rental boats, and may be due to a lower catch rate for shore fishing. The pier fee is low because most of the fishing from artificial structures takes place on jetties, where no fees are charged.

Trips which are taken in conjunction with overnight visits have different characteristics. Overnight visits can include vacations, business trips, visits to relatives, and visits for other purposes. Table NJ.7 gives some trip characteristics for trips which are part of overnight visits. Comparing the travel costs and time and distance traveled shows that these trips which are taken as part of overnight visits are much shorter. Travel cost is less than half that of the day trip travel costs. And the time traveled is much less, about 15 minutes per trip as opposed to more than 40 minutes. However, the costs of fishing services are similar. Bait costs average \$6.80.

similar to one day trips. Trips taken as part of overnight visits appear to be similar except for the distance travelled.

The UMCP survey also gives interesting information on the species group sought by mode. Some of this information is presented in Table NJ.8. Only trips taken by charter mode tend to seek big game. Flatfish are quite important as they are in New York. The rental mode is frequently used to pursue flatfish in the northern waters. The only mode where small game are the most important species is the beach mode. Flat fish are also sought frequently from piers and jetties.

Table NJ.1  
Two-Month Participation Rates\*  
by Wave and Year

Year	Wave				
	March- April	May- June	July- August	September- October	November- December
1980	3.5%	9.4%	12.2%	6.9%	2.1%
1981	3.5	7.6	12.6	6.8	2.4
1982	4.0	5.6	12.1	4.9	2.7
1983	3.2	6.1	10.8	5.4	3.1
1984	2.7	4.9	9.9	6.2	2.8
1985	3.3	6.5	8.7	5.9	2.4
1986	4.7	10.1	10.4	9.1	2.8
1987	2.1	6.2	8.4	5.3	2.9
1988	1.9	5.8	7.2	4.7	3.0
1989	1.0	5.0	6.3	5.8	1.5
Mean	3.0%	6.8%	9.9%	5.9%	2.6%

\* Percent of New Jersey coastal county households called who fished in New Jersey marine waters in the designated two months.

Table NJ.2  
Linear Trend Analysis<sup>1</sup> of Participation Rates,  
By Wave, 1980-1989

Wave	Constant	Linear Trend Coefficient	$\bar{R}^2$
March - April	.040 (7.94) <sup>2</sup>	-.0022 (-2.33)	.33
May - June	.080 (8.31)	-.0026 (-1.43)	.10
July - August	.129 (29.20)	-.0068 (-8.18)	.88
September - October	.067 (7.86)	-.0018 (-1.13)	.03
November - December	.026 (8.64)	-.0001 (-0.16)	.00

<sup>1</sup> Estimated model. was participation rate =  $\alpha_0 + \alpha_1$  time, with time defined as t = 0 for 1980, t = 1 for 1981 . . . , and t = 9 for 1989.

<sup>2</sup> T-ratio in parentheses.

Table NJ.3  
Trips Per Household Called  
By Year and Season\*

Year	Total	Wave				
		March- April	May- June	July- August	September- October	November- December
1980	.--	.06	--	--	.--	.03
1981	1.07	.10	.33	.37	.24	.03
1982	1.52	.10	.25	.79	.28	.09
1983	1.69	.15	.25	.88	.23	-.20
1984	1.60	.08	.22	.88	.31	.11
1985	1.61	.11	.35	.69	.37	.10
1986	2.26	.11	.57	.85	.57	.16
1987	1.70	.07	.47	.55	.41	.21
1988	1.46	.10	.40	.57	.29	.10
1989	1.13	.04	.30	.46	.29	.04
Mean	1.56	.09	.35	.67	.33	.11

\* Trips taken within state of residence.

Table NJ.4

Percent of Fishing Households Who Fish in Various Modes by Wave  
Mean 1981-1988

Mode	Wave				
	March- April	May- June	July- August	September- October	November- December
Shore	41.1%	32.9%	25.9%	38.0%	48.4%
Party/Charter	20.5	16.3	12.9	15.4	23.5
Private/Rental	38.5	50.7	61.2	46.6	28.1

Table NJ.5  
Percent Fishing Households Who Fish in Various Areas, by Wave  
Mean 1981-1988

Area	Wave				
	March- April	May- June	July- August	September- October	November- December
Ocean, Gulf, Open Bay	74.3%	69.4%	74.2%	73.1%	87.9%
Sound	1.7	.5	.4	.9	1.1
River	11.0	4.3	3.2	5.5	7.4
Enclosed Bay	10.3	25.8	21.9	16.7	3.2

Table NJ.6  
 Characteristics of Day Trips in New Jersey, by Mode  
 (per trip averages)

Characteristic	Mode					
	Pier	Beach	Party	Charter	Rental	Private
Travel Cost	\$7.39	\$6.07	\$10.37	\$11.86	\$19.58	\$11.72
Costs for						
Bait	4.01	3.43	1.06	16.75	7.45	8.52
Tackle	8.85	6.20	5.27	2.16	8.46	3.95
Cleaning	.53	.62	2.35	11.09	1.76	1.66
Fuel	--	--	--	--	8.21	15.08
Pier Fees	.32	--	--	--	--	--
Boat Fees <sup>a</sup>	--	--	26.31	104.8	46.95	--
Travel Time (in minutes)	46.27	43.92	55.9	59.6	52.3	46.9
Distance (in miles)	33.7	30.9	4.3	44.82	40.0	31.7
Boat Time to first site (in minutes)	--	--	49.73	88.54	33.0	29.4
Number of Observations	126	107	346	53	48	687

<sup>a</sup> Boat fees are charter and party fees or rental fees.

Table NJ.7  
 Characteristics of Trips for Overnight Visits in New Jersey

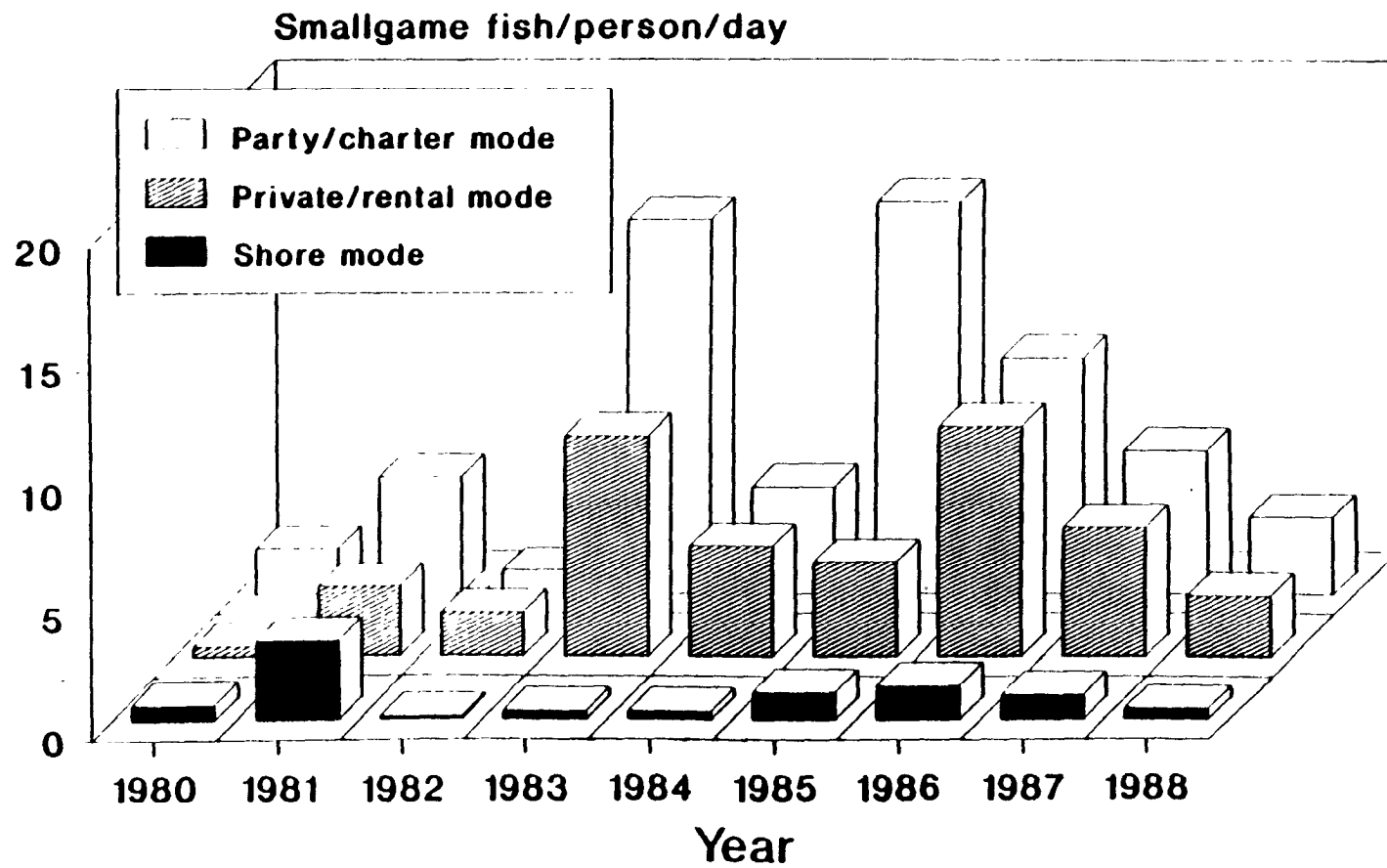
Characteristic	Mean	Number of Applicable Observations
Travel Cost	\$3.79	139
Cost for		
Bait	6.89	143
Tackle	9.43	142
Cleaning	1.04	143
Fuel	19.42	59
Pier Fees	.53	22
Boat Fees	94.12	30
Boat Rental	--	--
Travel Time (in minutes)	15.38	139
Distance (one-way) (in miles)	5.3	141
Boat Time (in minutes)	60.43	87
Trip Length (in miles)	15.68	144

Table NJ.8  
Percent of Trips Seeking Different Species Groups, by Mode  
for Day Trips

Species Group	Mode					
	Pier	Beach	Party	Charter	Rental	Private
Big Game	4.7%	0	3.1%	20.4%	2.1%	5.7
Small Game	32.9	71.7	35.8	46.9	23.4	35.7
Flatfish	47.1	25.0	30.6	20.4	70.2	54.7
Bottomfish	15.3	3.3	30.6	12.2	4.3	4.0

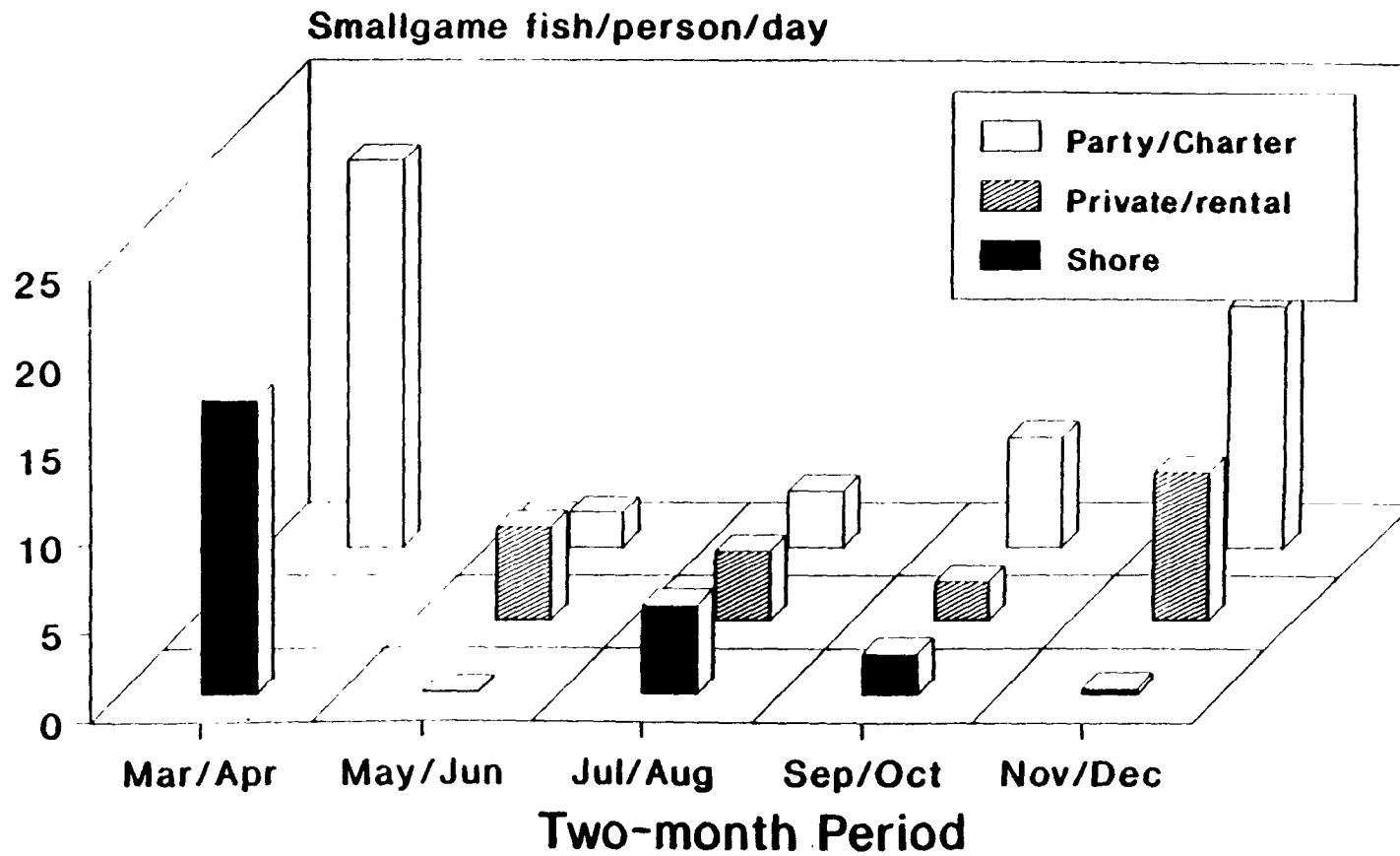
rfishnj.wp/ct/8-28-91

**Fig. NJ1: Smallgame Catch Per Day,  
New Jersey, Ocean,  
By Fishing Mode, 1980-1988**



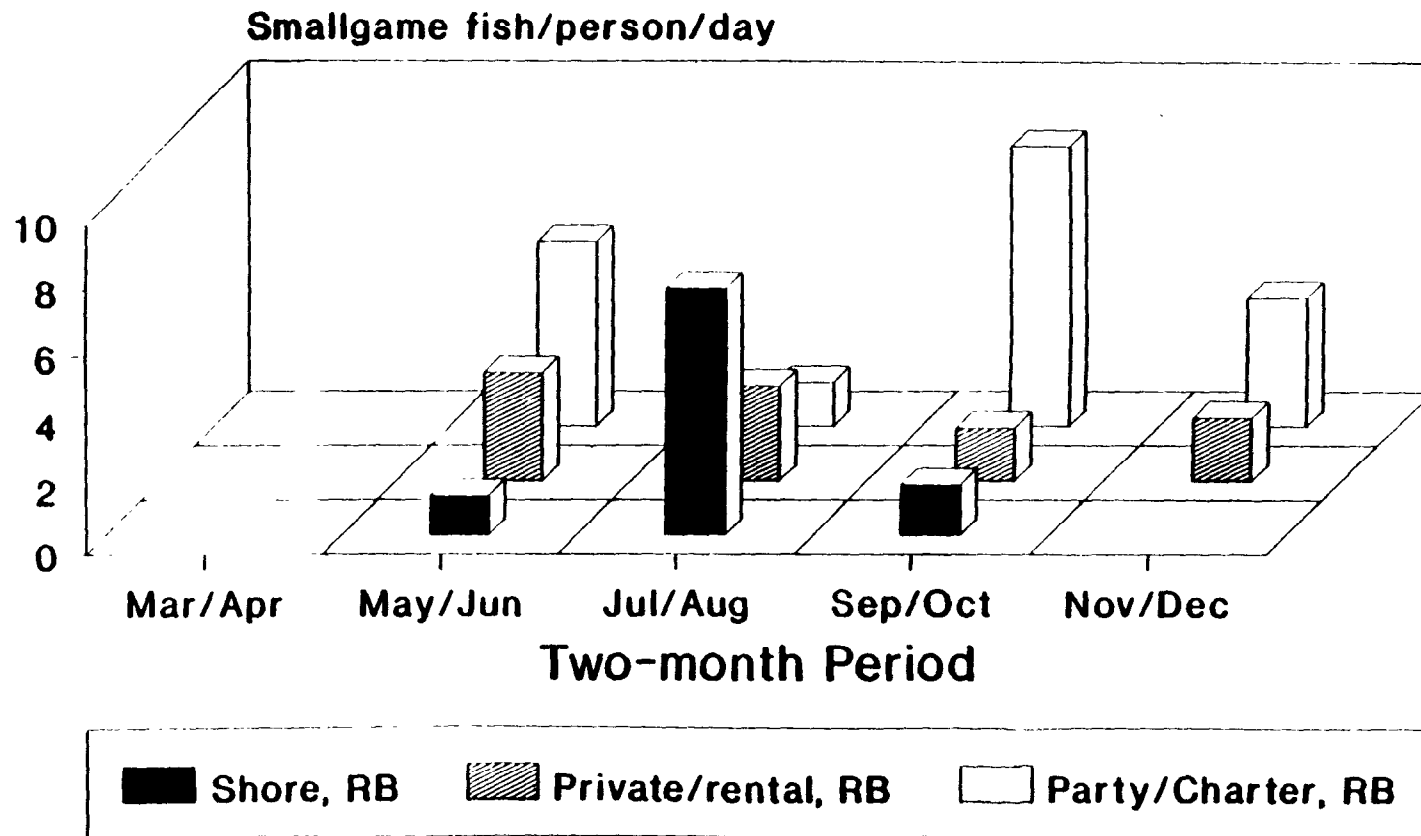
For individuals targeting smallgame.

**Fig. NJ2: Smallgame Catch Per Day,  
New Jersey, Ocean,  
By Wave and Mode**



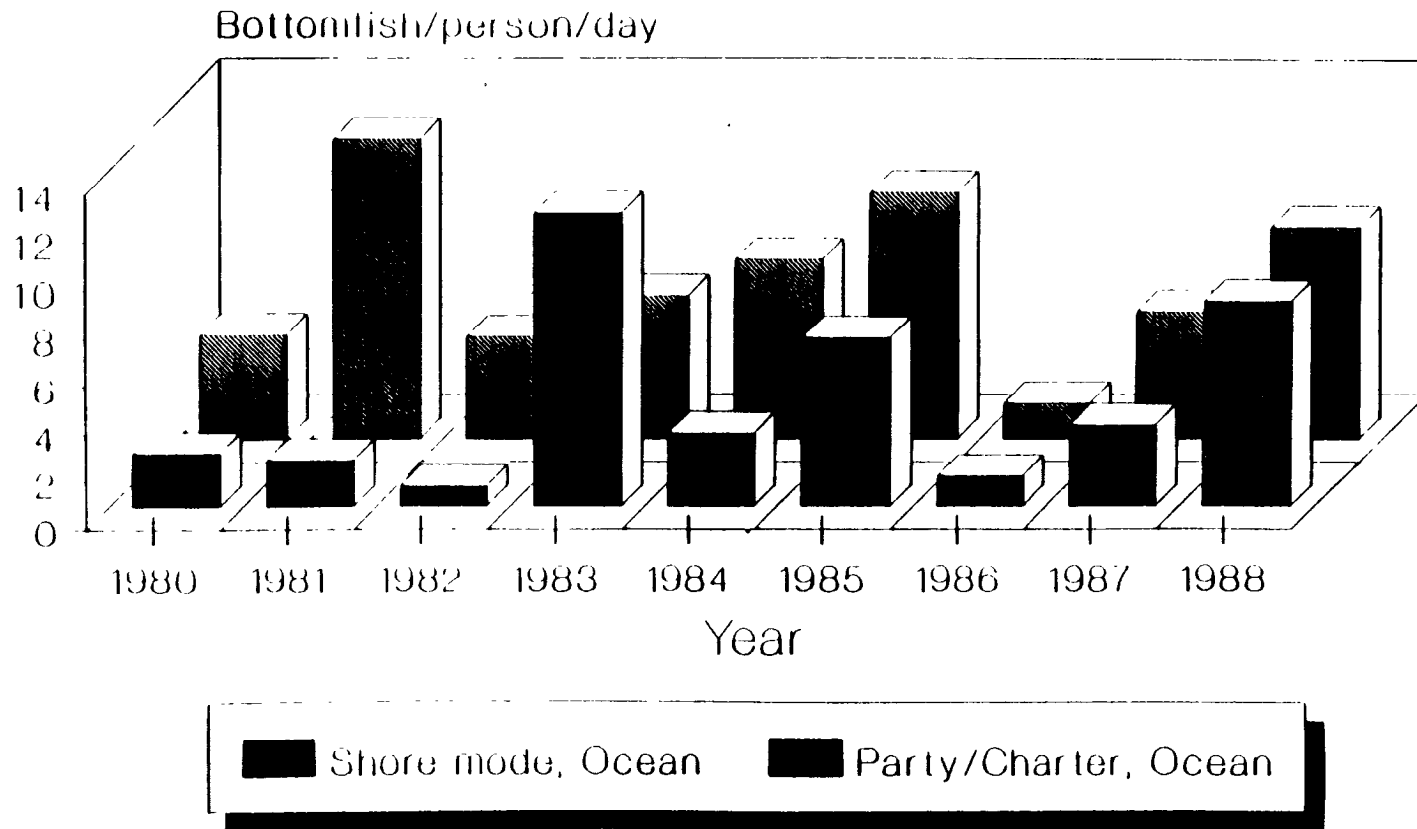
Average for individuals targeting small  
game, 1980-1988.

**Fig. NJ3: Smallgame Catch Per Day,  
New Jersey, Raritan Bay  
By Wave and Mode**



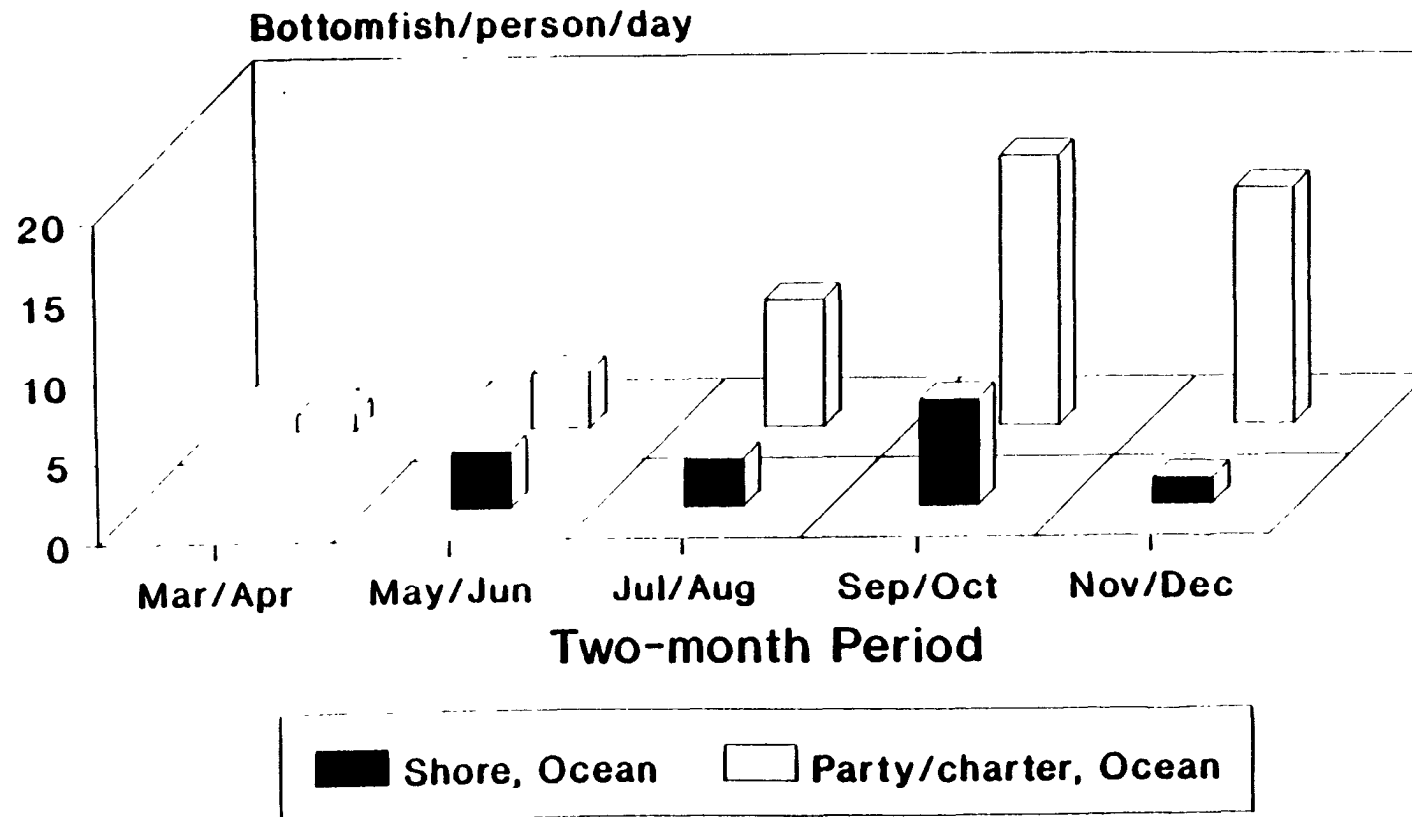
Average for individuals targeting small game, 1980-1988. No one who targeted smallgame was intercepted Mar/Apr.

**Fig. NJ4: Bottomfish Catch Per Day,  
New Jersey, Ocean Sites,  
By Fishing Mode, 1980-1988**



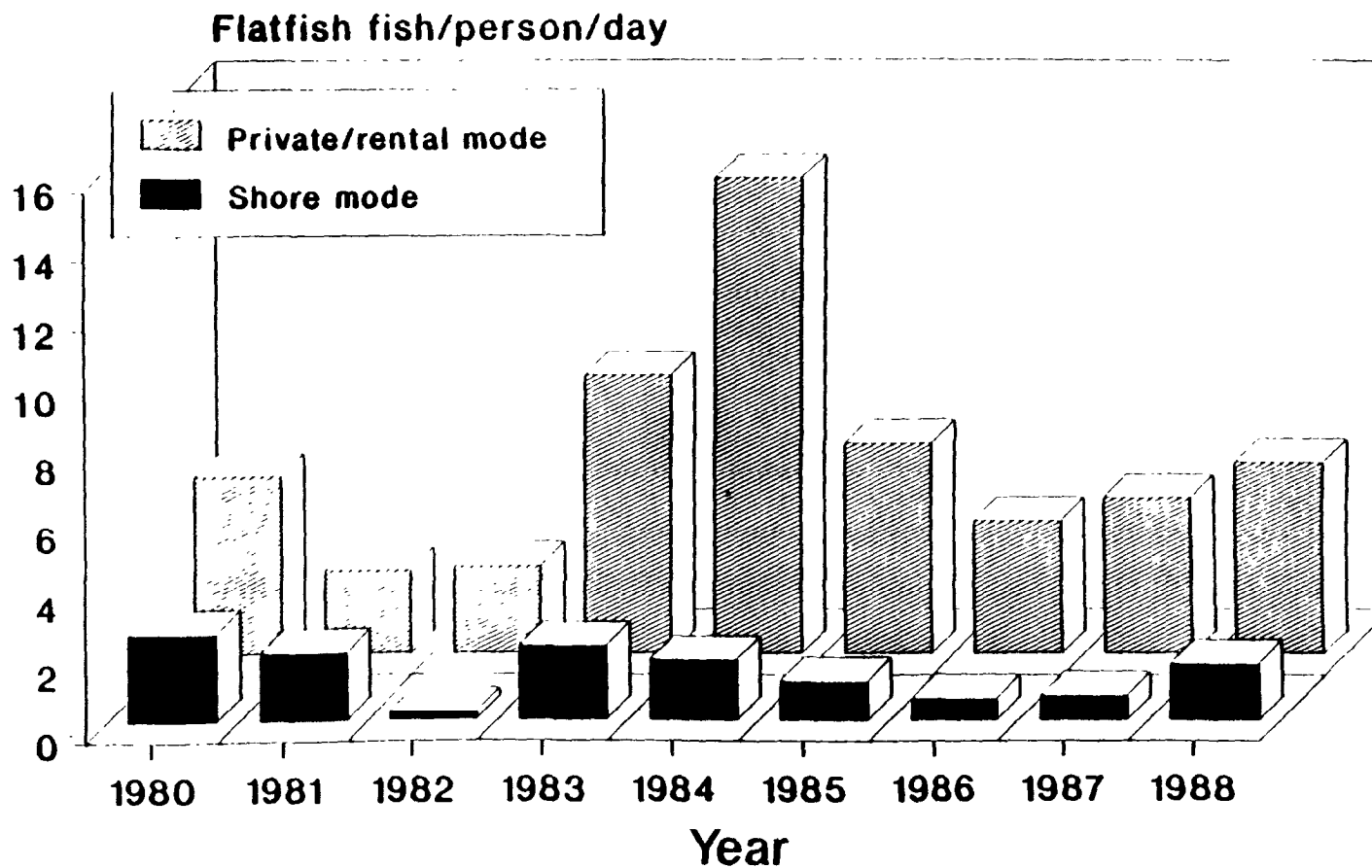
For individuals targeting bottomfish.  
Because of small sample, 1981 P/C figure  
is an average of 1980-1982.

**Fig. NJ.5: Bottomfish Catch Per Day,  
New Jersey, Ocean Sites  
By Wave and Mode**



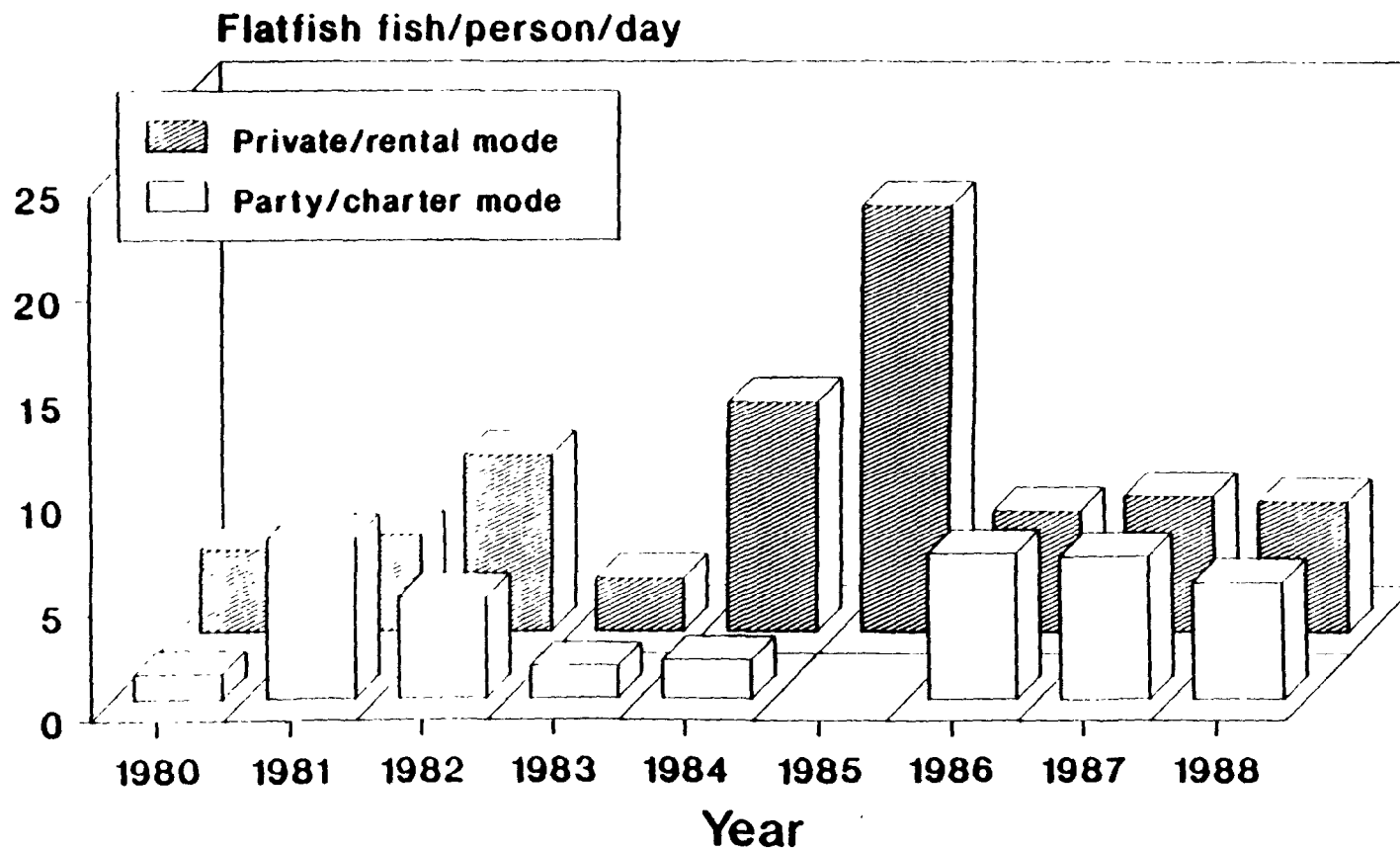
Average for individuals targeting bottom fish, 1980-1988. No one who targeted smallgame was intercepted Mar/Apr.

**Fig. NJ6: Flatfish Catch Per Day,  
New Jersey, Ocean,  
By Fishing Mode, 1980-1988**



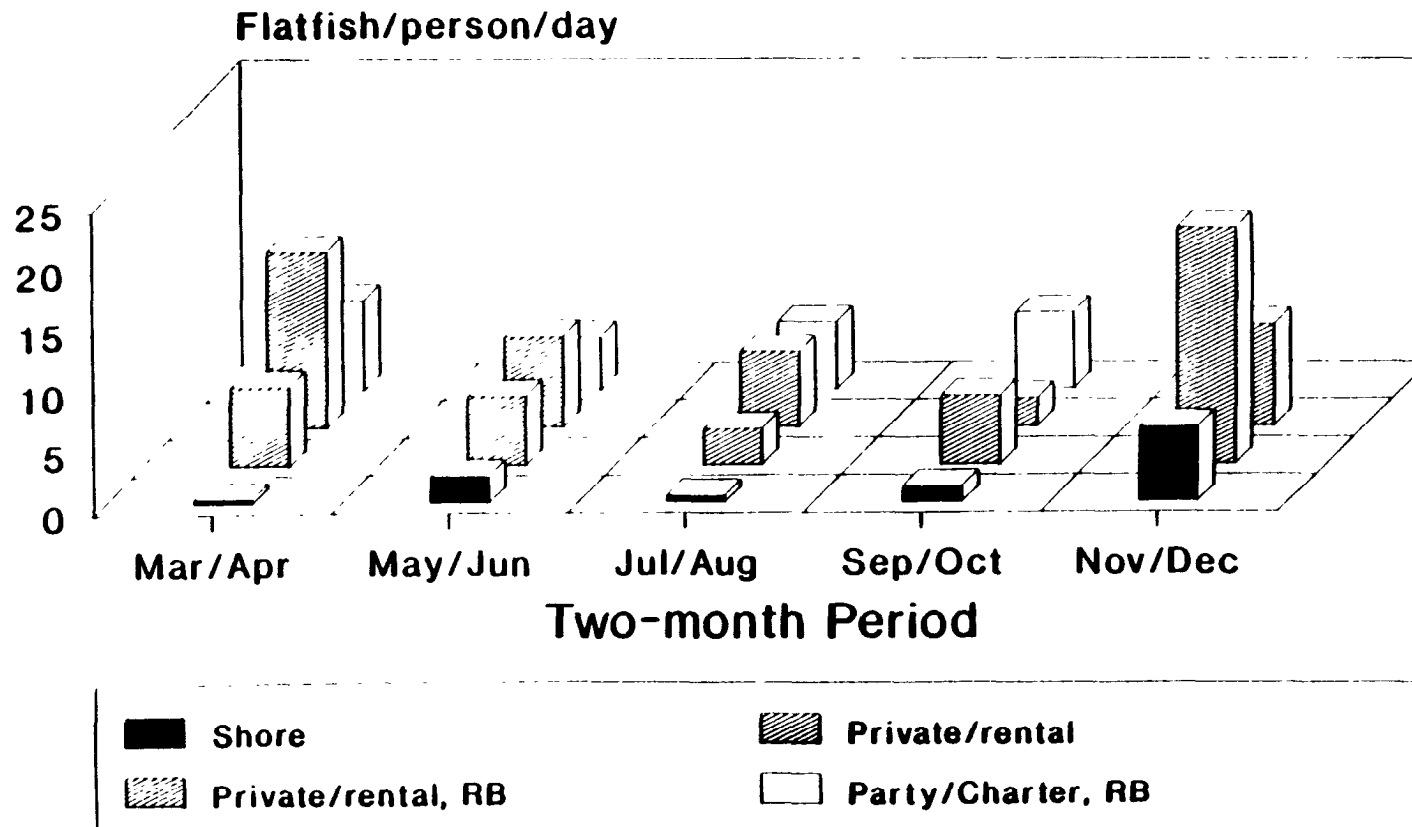
For individuals targeting flatfish

**Fig. NJ7: Flatfish Catch Per Day,  
New Jersey, Raritan Bay,  
By Fishing Mode, 1980-1988**



For individuals targeting flatfish  
No observations for 1985 party/charter.

**Fig. NJ8: Flatfish Catch Per Day,  
New Jersey, Ocean and Raritan Bay,  
By Wave and Mode**



Average for individuals targeting flatfish, 1980-1988.

## Chapter 4

# SPORTFISHING IN DELAWARE

### Activity by Delaware Households

Sportfishing is available on the Delaware Bay and the short strip of the Atlantic Ocean south of the Bay. There is also a small amount of well protected bay between Bethany and Rehoboth on the Atlantic coast. The population of Delaware is located northwest of the Atlantic, closer to the Delaware Bay, making sportfishing on that waterbody more accessible for most of the population. As with other middle Atlantic states, the climate of Delaware affords good fishing weather from late April through November. Migratory patterns of important species also induce some seasonality in the fishery.

The NMFS telephone survey is directed at all counties in Delaware, because all three border the coast. According to the 1980 Census, there were 211,500 households in Delaware and all were eligible to be called. The only fishing activity that occurs in Delaware that is not represented in the NMFS survey data is that enjoyed by non-residents of Delaware. This is fairly substantial because of the proximity of Maryland, Pennsylvania, and New Jersey. NMFS estimates that between 65 and 75 percent of the participants in Delaware's marine waters are from out-of-state, and about half of the trips taken to these waters are taken by out-of-staters.

#### *Sportfishing Activity: Household Participation Rates and Quantity of Sportfishing Trips*

A detailed picture of the seasonal and temporal participation rates by households is provided in Table DE.1. These figures give the percent of households called who had a least one person take a fishing trip in Delaware in the previous two months. The participation rates

vary from about 3 percent in the spring to about 12 percent in the mid-summer and back to about 2 percent in the late fall. The sample sizes range from a low of 178 for November-December 1986 to a high of 778 for July-August 1988. These sample sizes are generally large enough to assert that the wave participation rates are different from zero. Further, the means of participation rates by wave are significantly different from one another.

There is considerable variation, both across seasons and within season, in the participation rates. The mean July-August rate of 11.9 percent is quite high relative to other states in the Mid-Atlantic, and the 1.8 percent mean for November-December is relatively low. In some years, the seasonal variation is especially large. For example, in 1980, the proportion of households who fish ranges from about 2 percent in November-December to over 15 percent in July-August. The variation within seasons is also quite substantial. In May-June, the range is 6.9 percent, from a low of 5.3 percent in 1987 to a high of 12.2 percent in 1984 and 1986 while in September-October the range is 5.4 percentage points.

There is a very little trend pattern to the rates, although they appear to peak in the mid-1980's. A general characteristic of the trend coefficients in Table DE.2 is to be negative, although only the May-June wave's coefficient is statistically significant. The coefficients on the March-April and July-August waves are of similar magnitude to those estimated in New York and New Jersey. The May-June estimate is relatively large (in absolute value terms) compared with values observed in other states. It implies that the expected change in participation rate during May-June fell by 8 percentage points from 1980 to 1989.

The participation rates give information about the extensive margin--what is the distribution of fishing among households. They tell nothing about the intensive margin--how

frequently do households fish? The number of trips people take determines the magnitude of fishing, in terms of its use of people's time and its impact on the fish stocks. Table DE.3 gives trips per household called, by wave and year. These estimates are conservative in that they impute one trip to household members who are known to fish but who are not interviewed by phone. To extrapolate to the state of Delaware, simply multiply the trips per household called by the number of eligible households, which was 211,500 in the 1980 Census.

The seasonal variation is clear when the mean annual trips are apportioned among the seasons. For nine years of data, the mean trips are distributed as follows:

	<u>Mean Trips</u>	<u>Percent of Annual Mean</u>
March-April	.12	6.3
May-June	.50	26.3
July-August	.81	42.6
September-October	.41	21.6
November-December	.06	3.2

There is strong seasonality. Over 85 percent of the trips by Delaware households are taken in the period from May through October.

The trends in trips per household are similar to those in the participation rates. The annual rate peaks in 1984, and again in 1986 but fluctuates without clear trend the other years, although recovery towards the end of the period is evident. The individual waves are similar to the annual trip data, both in the tendency to peak in 1984 and 1986 and in the absence of clear trends elsewhere. As in Maryland, trips per household are lowest in 1985, the year of the striped bass moratorium.

### *Sportfishing Activity by Mode*

The distribution of fishing trips among modes describes where fishing activity takes place. Table DE.4 gives this distribution by mode and wave, averaged over the years 1981 through 1988. Modes differ in their perceived productivity of fish and their exposure to inclement weather over the seasons, leading fishing households to vary the choice of mode over the seasons. The proportion of fishing in the shore mode is high in the months of cooler weather, and declines substantially in the three mid-year waves. The private/rental boat mode increases as the weather improves, and peaks in the May-June wave. The party/charter mode also shows some seasonality, and accounts for quite a high proportion of trips relative to other middle Atlantic states in the summer months.

Table DE.4 gives the proportional distribution of trips among modes, not the aggregate level. To calculate the aggregate level of trips by mode and season, it is necessary to expand trips per household called (Table DE.3) to the population of households in the coastal counties of Delaware. The 1980 Census estimated 211,500 households in Delaware. According to Table DE.3, the mean number of trips per household in May-June was .5. Together these imply 103,635 trips by Delaware residents in Delaware May-June. Table DE.4 gives their distribution, implying for example that 64.1% of these trips, or 66,430 were private/rental boat trips. In July-August, Delaware households averaged .75 trips per household, or 158,625 total trips. Of these, 53.3 percent would be attributed to the private/rental mode, a total of 84,547. So even though the percent of trips in the private/rental mode falls from 64.1 in May-June to 53.3 in July-August, the aggregate quantity of trips rises from 66,430 to 84,547. These aggregate figures exclude fishing by households who do not live in Delaware.

### *Sportfishing Activity by Waterbody*

The categories of waterbodies included in the NMFS survey are given in Table DE.5. The figures in this table show the proportion of fishing trips in different water bodies. The category “enclosed bay” is especially troublesome for Delaware, because households can place fishing trips to the small bay along the Atlantic coast as well as in the Delaware Bay in this category.

To calculate numbers of trips to each type of water body, we first calculate the aggregate number of trips by wave. This expansion is accomplished by multiplying the mean number of trips per household called per wave by the number of eligible households - 211,500. For March-April the mean trips (from Table DE.3) is .12 and aggregate trips are 25,380 ( $= .12 \times 211,500$ ). From Table DE.5, 56.6 percent of them, or 14,365 are estimated to be taken in rivers. For May-June, mean trips per household called is .5, and aggregate trips are 105,750 ( $= .5 \times 211,500$ ). Of these trips, 5.5 percent or an estimated 5,816 are taken on rivers. Hence there is a substantial absolute decline in fishing on rivers from March-April to May-June.

### **Catch rates in Delaware**

Delaware’s small size and hence small sample size permitted consideration of only one area. Because such a large percentage of the sportfishing activity is in the Delaware Bay and Atlantic Ocean, catch rates reflect the availability of fish in those areas more than in the tributaries or enclosed bays.

The proportion of saltwater anglers who did not target a species is far greater in Delaware than the states to its north. In the five year period 1980-1984, 42 percent of the anglers intercepted in Delaware were not targeting a species. This percentage fell to 28 percent for the

period 1985-1988. Smallgame was the favorite target of Delaware anglers, with 33% of the anglers in the first period and 44% in the last period. The next favorite group was the flatfish. Although not nearly as popular as in New York and New Jersey, flatfish were the target for 23% and 18% of anglers in 1980-1984 and 1985-1988, respectively. Bottomfish dropped from 6% in the early period to 1% in subsequent years. Finally, big game was less than 1 percent consistently.

### *Smallgame Catch Rate*

There were two dominant species and one minor species of smallgame sought in Delaware waters during the decade. Sixty-three and seventy-three percent of anglers seeking smallgame were after weakfish in the pre-1985 and later period, respectively. The other major species was bluefish, attracting twenty-eight and twenty-two percent of the anglers in the respective periods. Finally, Atlantic mackerel was sought by six and four percent of the smallgame anglers in the pre-1985 and later periods, respectively.

Data permitted considering time trends only for the party/charter and private/rental boat modes (Figure DE1). Catch per day estimates were of similar magnitude, averaging around two fish per day, for the two modes. Also, the time trend in the two modes are quite consistent with one another, showing poor catch per day from 1980 to 1982 and in 1986. The middle of the decade and 1988 were the peak periods in availability.

The seasonal variation in catch rate is quite apparent the data (Figure DE2). The March and April period has abundant supplies of smallgame, if one is willing to brave the weather to get to them. After that period, catch rates drop off in May and June, only to rise again in the July through October period.

### *Bottomfish*

There were only about 500 anglers intercepted in Delaware during the study period who targeted bottomfish. Of those, fifty percent targeted tautog in pre-1985, a figure that rose to sixty percent in the 1985-1988 years. Black sea bass was also a choice in both periods, although the percent fell from around 20% before 1985 to around 8% after 1984. White perch and sandbar shark were important in the early period but were less important later.

The small numbers of targeting anglers meant no trends could be observed, but there were sufficient data to observe interseasonal catch rates for individuals on private/rental boats. The catch rates do not vary too dramatically over the year. The lowest was in November/December, around three fish per day per angler, and the highest was in May/June and September/ October, with about six per angler. This may have more to do with variability in number of hours spent fishing than availability of fish.

### *Flatfish*

The overwhelming species selected by anglers targeting flatfish in Delaware was summer flounder. Over ninety-seven percent of these anglers sought summer flounder over the decade. This compares with around 80% in New Jersey and only 40% in New York.

Because of the preponderance of summer flounder in the catch rate data, the trends shown in Figure DE3 for flatfish are really the trends in availability of summer flounder. They reflect a similar pattern to New Jersey, with the prime catch rates in the 1983-84 period and poor catch rates particularly in 1986.

The catch rate of shore fishermen targeting flatfish was generally less than one fish per day, uniformly less than anglers on party/charter boats and nearly always less than private/rental

boat fishermen (Figure DE4). The party/charter fishermen generally had the highest catch rates (< 3 fish per day) although the private rental boat fishermen were not too dissimilar. Fishing for flatfish is confined, probably by weather and availability, to the months from May to October. The best fishing from shore is in the May/June period whereas for the other two modes it comes in the July/August wave.

### **Characteristics of Fishing Trips in Delaware**

NMFS survey data from the phone survey and the intercept survey are gathered with the principal purpose of estimating total catch of fish for important species. They include basic information on trips and their distribution, but there is little information on the economic characteristics of trips. The UMCP survey allows us to describe some of the economic aspects of trips taken in Delaware. The following section describes some of this trip data for single day trips and trips taken as part of overnight visits to Delaware.

The economic characteristics of single day trips to Delaware are described in Table DE.6. These characteristics pertain to trips taken regardless of state of residence. The UMCP survey includes six modes: pier and other artificial structure, beach, party boat, charter boat, rental, and private boat. There are too few observations to make estimates for the rental mode. The travel costs for Delaware are quite high for all modes relative to other states. Anglers travel a considerable distance, and many come from out of state. The costs of services are roughly in line with the costs for other states (with the exception of tackle costs for the beach mode, which probably include a piece of durable tackle). Pier fees are quite low, reflecting the large number of jetties and small number of piers in the state. Payment for cleaning varies across the modes, but tends toward the two to five dollar range of other states.

The characteristics of trips taken as a part of overnight visits to Delaware are given in Table DE.7. These visits can be taken for many reasons, including vacation, business, etc. The Atlantic shore of Delaware is a popular vacation destination for people from Philadelphia, Baltimore, and Washington, and so it is likely that many of the overnight visits are for vacation. The travel costs for these trips (\$5.83) is naturally much lower, because people travel only from their overnight lodging. The costs of fishing services (bait, tackle, and cleaning) are similar to the single day costs. Basically, the costs appear to differ only with regard to the travel components.

Table DE.8 gives the distribution of trips by species sought and mode. Big game are of small importance for any mode. Flat fish are sought on a large percent of trips from party boats. Most of the trips are directed toward smallgame and flatfish.

Table DE.1  
Two-Month Participation Rates\*  
by Wave and Year

Year	Wave				
	March- April	May- June	July- August	September- October	November- December
1980	3.3%	-- %	15.3%	8.3%	1.6%
1981	4.9	12.1	12.3	5.0	1.0
1982	2.8	10.6	8.2	8.4	1.7
1983	4.6	7.8	14.5	9.2	1.7
1984	5.1	12.2	14.7	10.4	2.0
1985	2.4	8.5	10.2	6.4	2.7
1986	4.5	12.2	11.0	7.1	2.4
1987	3.0	5.3	9.9	9.7	2.3
1988	1.9	6.7	13.1	7.1	1.0
1989	2.4	9.5	9.7	5.8	1.7
Mean	3.5%	10.3%	11.9%	7.7%	1.8%

\* Percent of Delaware coastal county households called who fished in Delaware marine waters in the designated two months.

Table DE.2  
Linear Trend Analysis<sup>1</sup> of Delaware Participation Rates,  
By Wave, 1980-1989

Wave	Constant	Linear Trend Coefficient	$\bar{R}^2$
March - April	.043 (6.75)	-.0019 (-1.57)	.14
May - June	.139 (8.21)	-.0080 (-2.52)	.37
July - August	.133 (9.56)	-.0031 (-1.18)	.04
September - October	.081 (7.42)	-.0007 (-0.34)	.00
November - December	.017 (4.90)	.0004 (0.55)	.00

<sup>1</sup> Estimated model was participation rate =  $\alpha_0 + \alpha_1$  time, with time defined as  $t = 0$  for 1980,  $t = 1$  for 1981 ..., and  $t = 9$  for 1989.

<sup>2</sup> T-ratio in parentheses.

Table DE.3  
Trips Per Household Called  
By Year and Season\*

Year	Total	Wave				
		March- April	May- June	July- August	September- October	November- December
1980	--	--	--	--	--	--
1981	1.61	.39	.43	.59	.16	.06
1982	1.44	.07	.50	.40	.44	.03
1983	1.81	.06	.50	.69	.53	.03
1984	2.49	.11	.52	1.15	.59	.13
1985	1.33	.17	.33	.60	.18	.05
1986	2.66	.14	.85	1.18	.43	.06
1987	1.46	.06	.29	.78	.26	.06
1988	1.90	.03	.53	.88	.44	.02
1989	2.37	.08	.56	1.00	.66	.07
Mean	1.90	.12	.50	.81	.41	.06

\* Trips taken within state of residence.

Table DE.4  
Percent of Fishing Trips in Various Modes by Wave  
Mean 1981-1988

Mode	Wave				
	March- April	May- June	July- August	September- October	November- December
Shore	57.5%	26.3%	34.2%	35.6%	49.2%
Party/Charter	3.7	9.6	12.5	13.4	11.1
Private/Rental	38.9	64.1	53.3	51.0	39.8

Table DE.5

Percent of Fishing Trips in Various Areas, by Wave  
Mean 1981-1988

Area	Wave				
	March- April	May- June	July- August	September- October	November- December
Ocean, Gulf, Open Bay	33.4%	56.0%	55.1%	62.0%	85.2%
Sound	6.7	.2	.4	1.0	0.0
River	56.6	5.5	9.1	13.6	7.5
Enclosed Bay	8.7	37.7	34.9	23.1	7.3

Table DE.6  
 Characteristics of Day Trips in Delaware, by Mode  
 (per trip averages)

Characteristic	Mode					
	Pier	Beach	Party	Charter	Rental	Private
Travel Cost	\$28.96	\$12.72	\$25.49	\$22.96	<sup>b</sup>	\$13.81
Costs for						
Bait	2.47	4.24	2.80	1.07		6.98
Tackle	1.94	19.23	5.99	1.62		3.51
Cleaning	.68	8.25	1.22	3.51		1.88
Fuel	--	--	--	--		14.15
Pier Fees	.10	--	--	--		--
Boat Fees <sup>a</sup>	--	--	31.19	44.50		--
Travel Time (in minutes)	54.7	59.7	98.4	123.4		69.5
Distance (in miles)	68.9	44.4	59.8	90.2		48.9
Boat Time to first site (in minutes)	--	--	62.0	58.5		31.8
Number of Observations	33	64	55	46		237

<sup>a</sup> Boat fees are charter and party fees or rental fees.

<sup>b</sup> Not enough observations for precise estimates.

Table DE.7

## Characteristics of Trips for Overnight Visits in Delaware

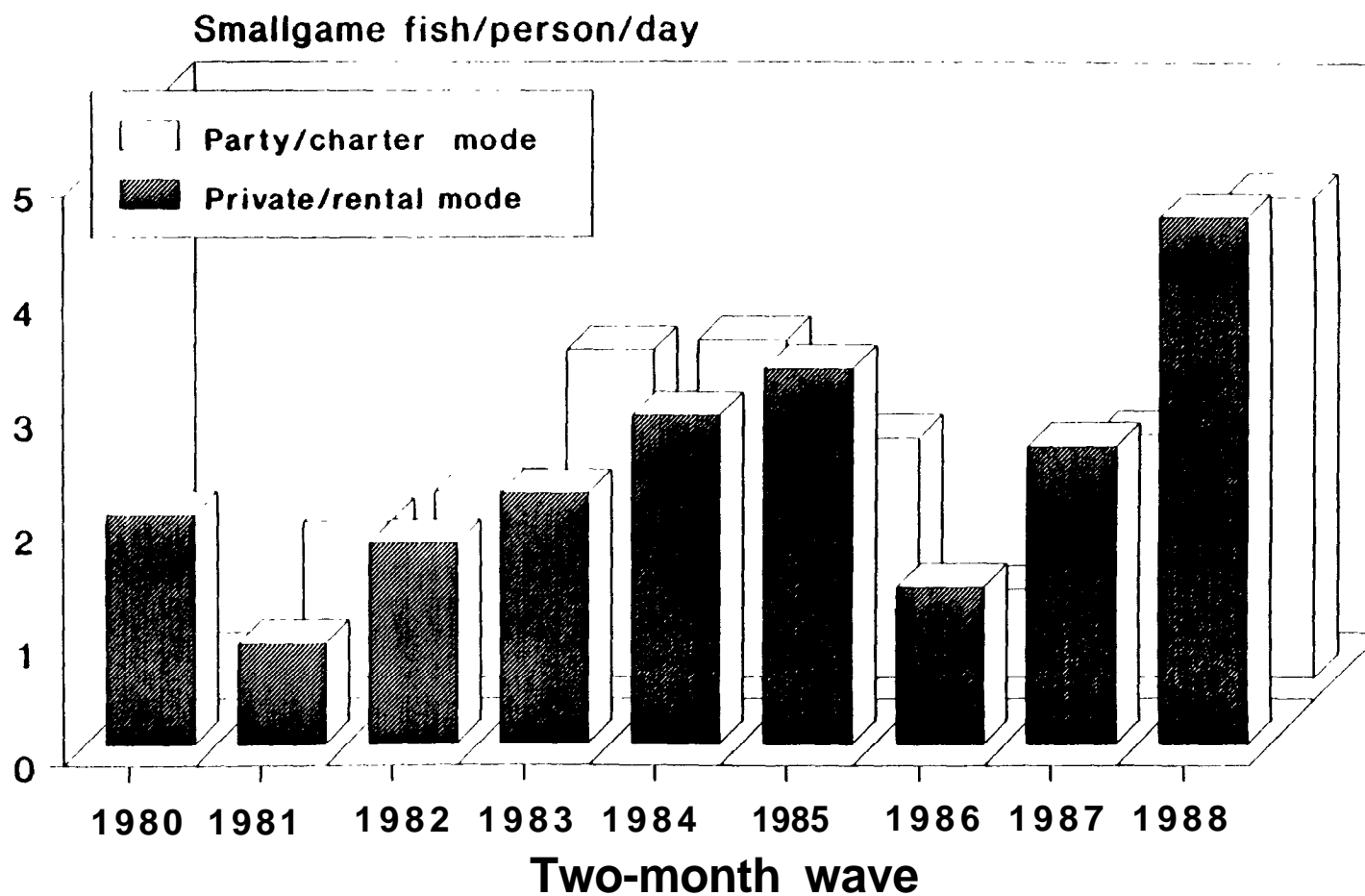
Characteristic	Mean	Number of Applicable Observations
Travel Cost	\$5.61	110
Cost for		
Bait	3.66	112
Tackle	1.63	112
Cleaning	1.56	112
Fuel	8.71	54
Pier Fees	.15	17
Boat Fees	66.42	20
Boat Rental	<sup>a</sup>	<sup>a</sup>
Travel Time (in minutes)	15.6	111
Distance (one-way) (in miles)	10.7	110
Boat Time (in minutes)	35.3	74
Trip Length (in days)	14.8	112

Table DE.8  
Percent of Trips Seeking Different Species Groups, by Mode  
for Day Trips

Species Group	Mode					
	Pier	Beach	Party	Charter	Rental	Private
Big Game	0.0%	8.0%	2.1%	9.4%	?	4.9%
Small Game	65.4	80.0	51.1	71.9	?	54.2
Flatfish	23.1	10.0	46.8	12.5	?	35.6
Bottomfish	11.5	2.0	0.0	6.3	?	5.4

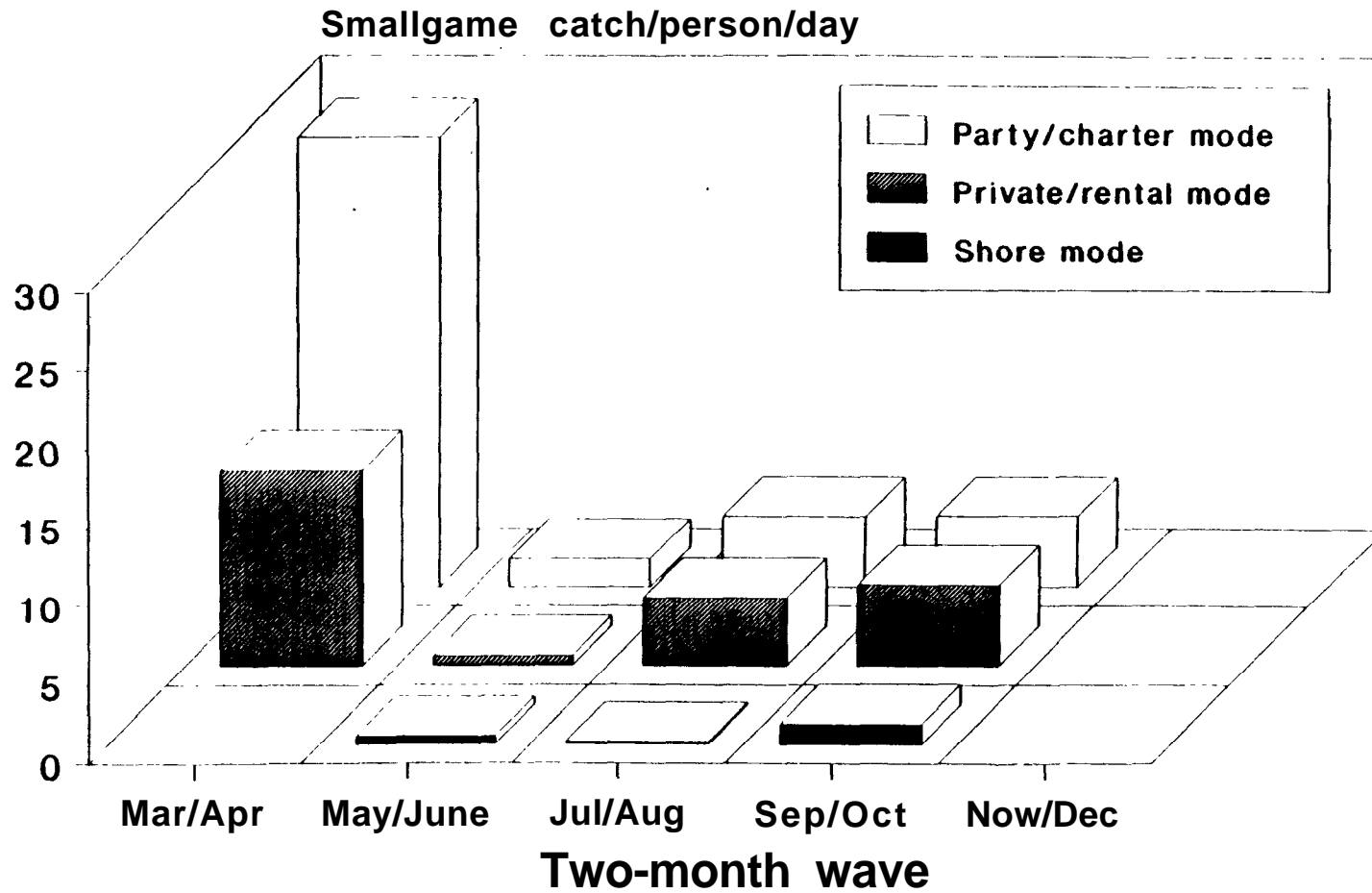
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**Fig. DE1: Smallgame Catch per Day,  
Delaware, By Mode and Year**



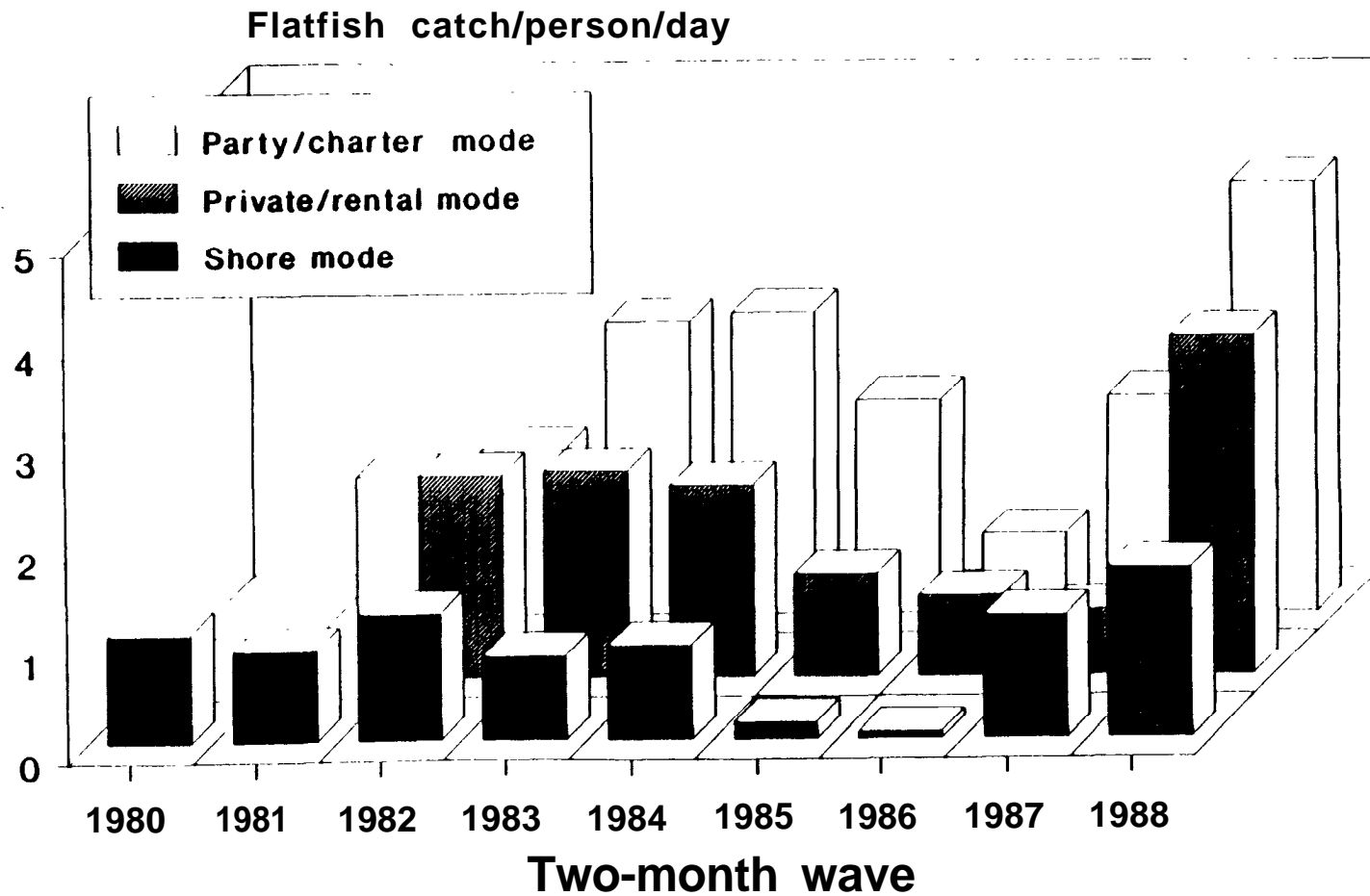
Average for anglers targeting smallgame,  
1980-1988

**Fig. DE2: Smallgame Catch per Day  
Delaware, By Wave and Mode**



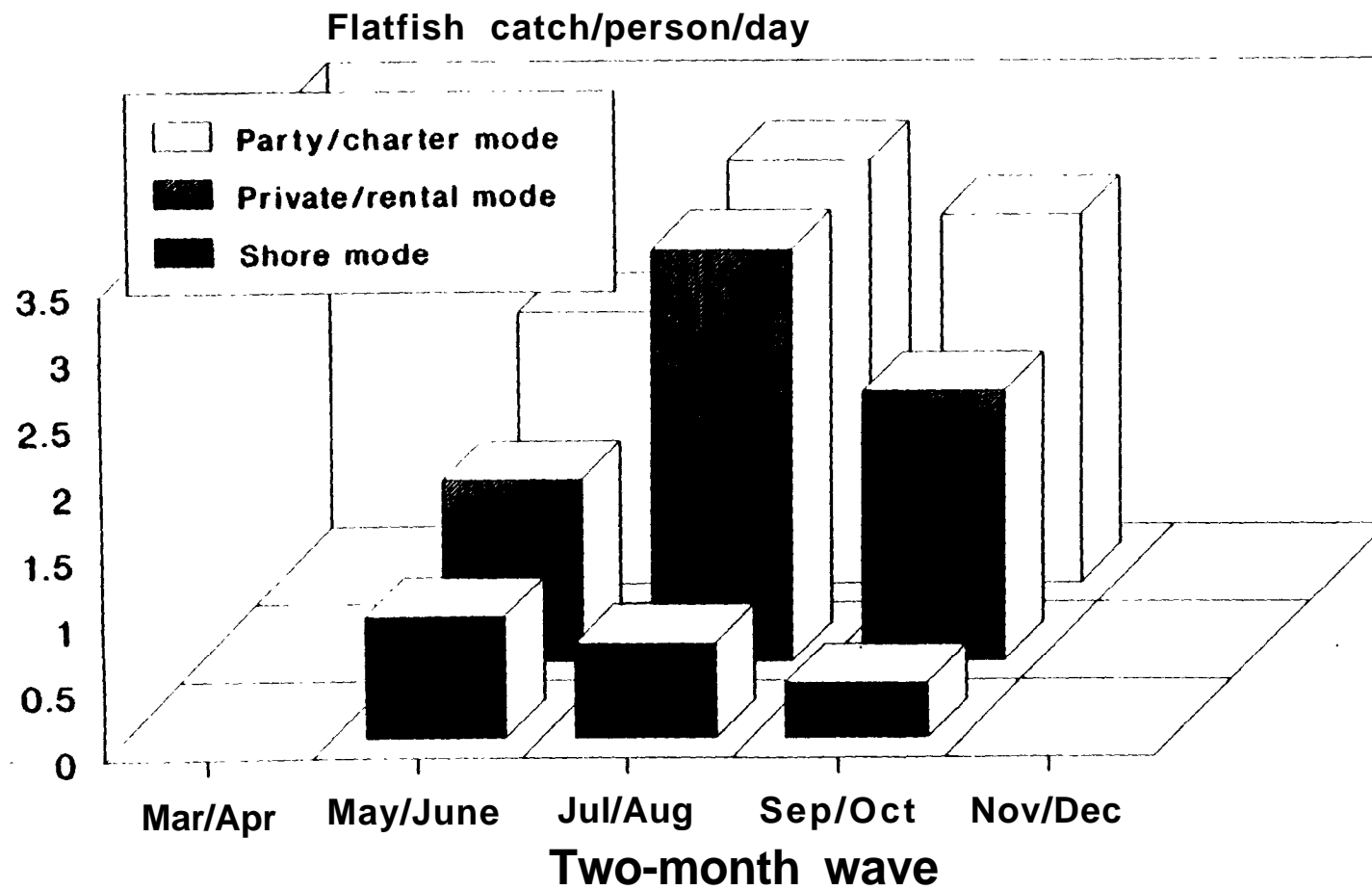
Average for anglers targeting smallgame,  
1980-1988

**Fig. DE3: Flatfish Catch per Day  
Delaware, By Mode and Year**



Average for anglers targeting flatfish,  
1980-1988

**Fig. DE4: Flatfish Catch per Day  
Delaware, By Wave and Mode**



Average for anglers targeting flatfish,  
1980-1988